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Spring 1994

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CRIMEWATCH

RADIO!

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Scanner Listening

Shortwave and AM Broadcast Band Listening

Communicating

Technical

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On the Cover: Capt. Robert Shore of American Airlines talks on the radio from the cockpit of a 757 at Newark Airport, Newark, NJ. Photo by Larry Mulvehill, WB2ZPI.

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Welcome to the inaugural issue of Radio! *This exciting new publication is your comprehensive guide to the world of communications that is available exclusively to Radio Shack customers.*

Radio! *will cover the entire communication spectrum with articles of interest to amateur radio operators, scanner, CB, and shortwave enthusiasts as well as first-time hobbyists. Each issue of* Radio! *will feature authoritative articles, product reviews, and construction projects contributed by many of the best known and highly respected authors in the field.*

Our intent is to offer Radio Shack customers insights into communication technology, provide product feature and specification information, and share tips on what to look for when considering a new product purchase.

We hope Radio! *will be your source for useful information about the extensive range of communication products and services available today.*

This is your magazine. The editors of Radio! *welcome suggestions from readers about what you would like covered in future issues. Your thoughts and ideas for making* Radio! *even more useful will be appreciated.*

Remember, Radio! *is sold only in Radio Shack stores nationwide at the bargain price of $1.95.*

We hope you find Radio! *interesting and informative.*

Robert B. Miller AA5FL

Vice-President, Radio Shack

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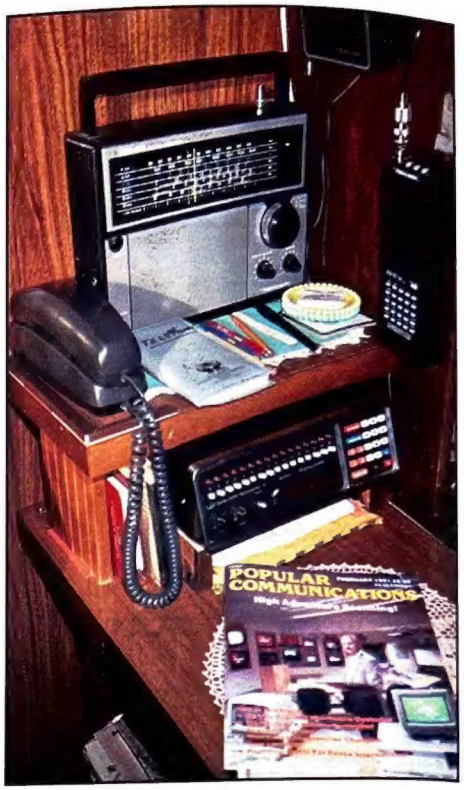
WORLD BEAT

The scanning action becomes especially busy during natural disasters, such as the recent Mississippi River flooding in the Midwest. Be sure to check all emergency service frequencies during such problems. (Photo by Chuck Gysi, N2DUP.)



This convenient listening post belongs to Clifford Duncan of Cut Knife, Saskatchewan. A base scanner, handheld scanner, and shortwave radio offer plenty of monitoring opportunities.

Scanning The Action Bands

With up to 400 channels, what in the world are you going to program into your scanner? Here's what to listen to besides your local police and fire departments.

By Chuck Gysi, N2DUP

Welcome to the fantastic world of scanning, or monitoring, as it's also sometimes known. Many of us in the hobby refer to ourselves as scanners or scannists (a somewhat contorted term), but we're also known as monitors. And, if you're reading this article now, you're probably ready to become a scanner yourself.

History of the Hobby

The term "scanner" is derived—obviously—from the use of scanners (also misnamed "police radios" by those who don't know better); the term "monitor" goes back to before the advent of scanners. Before all the bells and whistles were added to VHF and UHF radio receivers, most enthusiasts could "monitor" only a single channel at a time, either static and crystal-controlled or with a tunable dial. Not until scanners, which scanned through a series of four to eight channels, were introduced in the late 1960s could one monitor more than one channel at a time.

The hobby of tuning in police transmissions goes back even further. In the 1950s, VHF frequencies started becoming popular for public safety. Then, the police radios were actually receivers with cumbersome antennas and allowed patrol units to hear "broadcasts" from police headquarters at the upper end of the AM broadcast band (above 1600 kHz). Two-way radio systems for public safety use really didn't materialize until the 1940s and 1950s.

Because the original monitor radios manufactured from the 1950s through the mid-1970s received only one frequency at a time, most people used them to hear their local police or fire departments to know what was going on in the neighborhood. More often than not, those who owned these receivers were fire fighters, rescue squad members, or police officers. The hobby of scanning really didn't take off among the general

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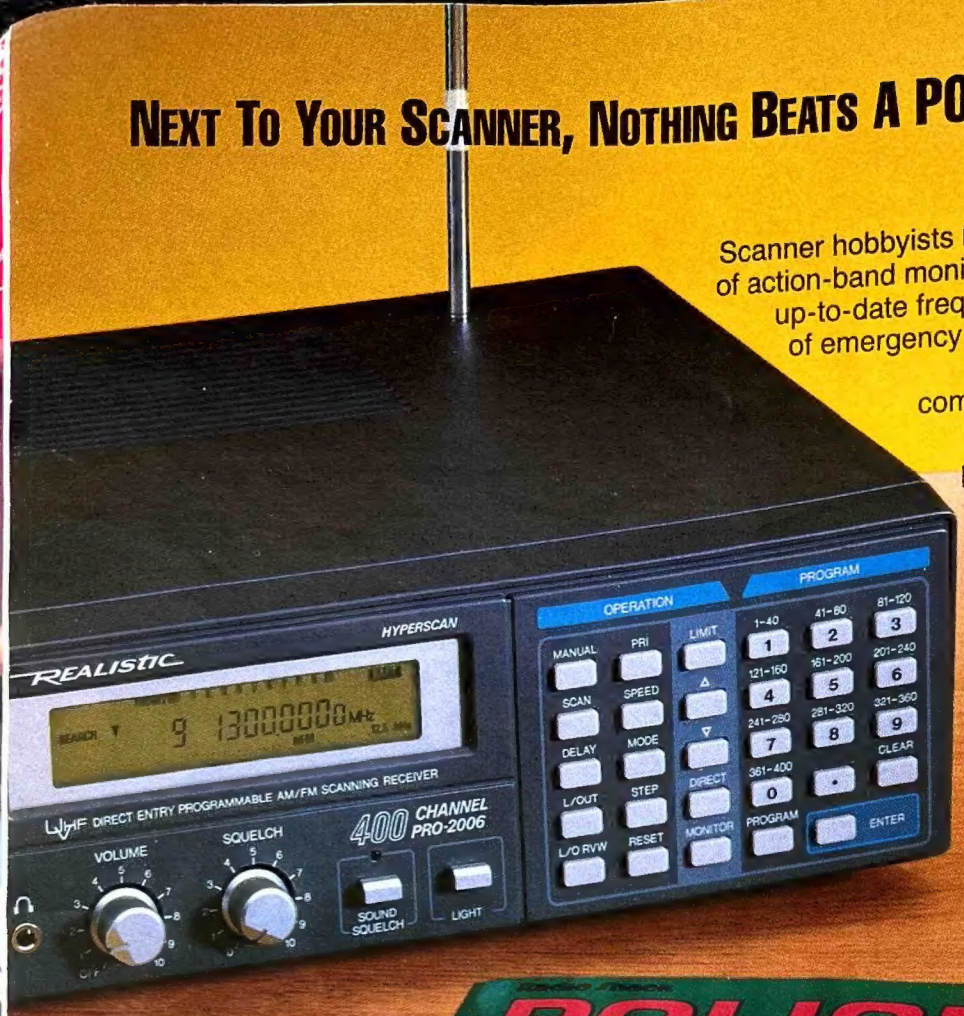
POLICE CALL also contains a helpful illustrated Listener's Guide with easy-to-read sections on such topics as radio theory, scanner technology and antennas. It's a wealth of information for beginners and "pros" alike.

Your nearby Radio Shack store carries the all-new 1994 edition of **POLICE CALL** plus more than a dozen different scanners and a complete line of accessories. Keep **POLICE CALL** next to your scanner and hear the action . . . as it happens.



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INSIDE INFO

Ambulances usually can be found communicating patient status to hospital emergency rooms in the 155, 463 and 468 MHz ranges. (Photo by Chuck Gysi, N2DUP.)

Radio stations doing live remotes will send the program from the scene back to the studio on the 153, 161, 450 and 455 MHz bands. (Photo by Chuck Gysi, N2DUP.)

public until the mid-1970s when frequency-programmable scanners started becoming popular and frequency guides such as *Police Call* became available over the counter.

The first scanners used crystals, which were small plug-in modules that "told" the scanner what frequencies the listener wanted to hear. For instance, if you wanted to listen to your police department on 39.28 MHz, you had a crystal for that frequency plugged inside your radio. Each of the four to eight channels (and as many as 20 channels) required a crystal for the particular frequency you wanted to hear. Getting crystals for all your listening habits could prove expensive, as many early monitor hobbyists found. For instance, at about $5 per crystal, it cost at least or $40 just to have eight crystals on hand for the radio. Most early scanner hobbyists had—and probably still have kicking around in their listening posts—a box of crystals. Some of the most popular crystals were those of mobile telephone channels in the 152-MHz range.

In an effort to get around the need for these crystals by synthesizing the desired frequencies within the radio itself, the first programmable scanners had all types of tricks to them. For instance, some of the early programmable scanners incorporated tricks such as using binary codes in the programming of each channel, using punched cards for each desired program (in other words, change one frequency in an eight-channel group and you had to use an entirely new card), metal combs that were cut for various frequencies. There might even be an add-on box that you used to dial in the frequency for each channel by turning a rotary dial to the desired numbers for each number in the frequency.

Eventually, scanners could be programmed by entering the frequency directly through a keyboard. The first such scanners appeared on the market in the mid-1970s and have become today's standard. In fact, there are no new scanners being manufactured that allow you to use crystals for each channel you want to hear. Even the low-end budget scanners are programmable, offering thousands of possible frequency selections for the user.

Why a Scanner?

So why should you buy a scanner? Most people still buy them to find out more about what goes on in their neighborhood or the larger community. There's a natural curiosity about why an ambulance went speeding past your home last night, why a police car sped past you on Main Street on your way to work, or why there were fire trucks in front of your neighbor's home while you ate dinner.

Scanning brings home the action. You become an informed citizen when you know more about your neighborhood and local community.

What to Buy

If you're buying a scanner for the first time and really haven't previously experienced scanning, you probably should start out with a basic unit and learn as much as you can. Most low-end budget scanners offer 10 to 16 channels that you can program and also might offer a search function to find new frequencies. That's all you need to get started.

If you have had a basic scanner for some time and enjoy using it, you probably are ready to start looking at a model with more features (such as the 800 and 900 MHz or aircraft bands), with more channels (from 20 to 400), and with more bells and whistles (such as Sound Squelch). By moving up to a better model of scanner, you will offer yourself other aspects of the hobby that were not available on your basic scanner.

Programming Your Scanner

When you first get your scanner, you also should purchase a frequency guide. The *Police Call* directory at all Radio Shack stores is a good start. Program in all the frequencies used in your city or community. If you live in a large city, you'll fill up those first few channels fast. If you live in a rural area, however, and you still have a few channels left over after you get the local stuff installed, try looking at frequencies for neighboring communities or your county. For instance, while you might program in the local police, you also should check for frequencies used in your area by your county sheriff, the state police or highway patrol and highway trucks (county, city, and state).

If you live on the border of another county or even another state, you might consider listening to those areas, too, if you still have room to program channels.

But how *else* can you find things to listen to on your scanner? In the back of *Police Call* are several other listings outside the routine police, fire, and emergency services frequencies. Perhaps the railroad passes through your town. If so, you might want to listen to some of the frequencies used by those rail lines, particularly frequencies listed as "road," since they are more active! If you live near a lake, river, or ocean, you might consider programming in some of the VHF marine channels, especially the emergency and calling frequency, 156.800 MHz, also known as Channel 16. And again, if you live near a military installation, check out the list of its frequencies and program in a few to hear our service men and women at work.

Once you master programming in various frequencies, you're ready to try the search feature on your scanner, if it is so equipped. What the search feature does is automatically scan all frequencies between two given frequencies for any possible action. For instance, you might set your scanner to search for communications on frequencies between 155 and 156 MHz. Your scanner might stop on 155.205 and pick up an ambulance getting dispatched on an emergency call, or on 155.340 for an ambulance calling a hospital with a patient report as it heads to the emergency room. Or perhaps it will stop on 155.805 and pick up a road crew patching potholes; or 155.385 for a medical helicopter enroute to an accident scene; or 155.415 for a college police force; or 155.505 for a state trooper calling for backup at a vehicle stop. And so on. You see, as long as there are communications on those frequencies, your scanner will catch the action for you. This is the way you find new frequencies in your area.

Your local police department, for example, might use 155.670 MHz for routine dispatch and communications. One day, however, you may hear two units using that frequency say, "switch to F2" or "move to the new channel." Your local frequency directory might not show any additional frequencies licensed to your town, but, with a little detective work, you can usually track down their "new channel" or their switch-over F2 frequency. Most of the time, addi- tional frequencies used by an agency will be in the same area of the frequencies already used. Since the police department in the example here uses 155.670 MHz, you would be best to search in the range from 154.650 to 156.210 (note that this is a range police departments can use, according to the listing of frequencies and their users in *Police Call*). Right after you hear the two mobile units switch to their other channel, start your scanner in the search mode. If you're lucky, the search feature will stop on the channel you're looking for. In a metropolitan area, a lot of frequencies will be in use by a lot of various agencies, but in rural areas it's a cinch to sniff out the new frequency. These are the things that excite scanner listeners: finding new or unpublished frequencies.

Features

Do you really need the 800 or 900 MHz bands on your scanner? How about aircraft bands? The quick answer to the first question is that, if you live in large metropolitan area, you probably will want to have the 800 MHz band. While most low-end budget scanners won't include this band, you might want it if you live in an area such as Dayton, Ohio, where the emergency services use the band, or in New Jersey, where the state police use it. If you live in Iowa, however, you probably can get along without it (unless you live in Iowa City, which uses the band). You'll need to ask the sales personnel when you buy your scanner if the 800 MHz band is necessary for where you live.

While some metropolitan areas use the 800 MHz band for public safety communications, the band is also host to a lot of business communications, both on private and shared systems. The 900 MHz band is used almost exclusively in the nation's largest cities. This band is also used on a very limited basis by hams, as well as for paging and business communications, again both shared and private systems. Some radio station studio-to-transmitter links also can be found here.

As you can see, you will probably want a scanner with a search feature, if listening to more than just your local police and fire departments interests you. While the 150-174 MHz band is used by police and fire departments, you'll also find highway crews, business users, boats, weather broadcasts, trash trucks, railroads, trucking lines, tow trucks, taxicabs, industrial plants, radio and TV station news crews and remote

The well-equipped listening post of Les Mattson, the editor of Northeast Scanning News *in Paulsboro, NJ. Scanners keep tabs on the action in his community as well as nearby Philadelphia.*

The signals you hear on police frequencies often come from dispatch centers such as this one in East Hampton, NY. This center not only handles police calls, but also communications for fire, ambulance, village government, and fire and ambulance units in surrounding towns. (Photo by Bruce V. Backlund.)

Several scanners from Radio Shack make a tidy listening post for enthusiast Jason Miller of Garland, TX.

broadcasts, ambulances, school buses, veterinarians, lifeguards, paging, fast-food drive-through order windows, park rangers, FBI agents, newspaper reporters and photographers, hospital security, and much, much more. All it takes is a little effort and your search feature.

Keep a log of what you hear. If you can't figure out what you've tuned in, program the frequency into an open channel on your scanner and monitor it for several days. After a little listening, you might be able to figure out what you're hearing via the context of the communications heard.

The same basic principle applies for other bands on your scanner, too. You'll be able to tune in similar types of communications on the VHF low band from 30 to 50 MHz and on UHF from 450 to 470 MHz. In the nation's top 20 metropolitan areas, various segments of the 470-512 MHz band might be used for various interests, such as public safety and business. For instance, public safety agencies and others use the 500-512 MHz bands in the Philadelphia area, while the 470-482 MHz bands are used in the New York City area.

Also, many scanners are equipped with the 108-137 MHz aircraft, or aviation band. You won't find routine communications in the 108-118 MHz band, so if your receiver omits this segment, don't worry about it. This is where beacons transmit to enable aircraft to keep track of their bearings on the ground. There is a lot of traffic to be heard, however, in the 118-137 MHz aircraft band. If your scanner must be set, be sure you are in the "AM" mode, not in the "narrow FM" mode used on most other scanner bands. Aircraft transmit in the AM mode and can typically be heard for hundreds of miles. If you have an outside antenna connected to your scanner, you'll be able to hear the aircraft as they communicate with various flight controllers along their flight path. In addition, several frequencies are used by the aircraft to communicate with their own companies, therefore known as "company frequencies." It's on these frequencies that commercial airline pilots will radio ahead if there are passengers on board who need to make connections or if additional meals need to be loaded at the next stop. Some frequencies also support airplane-to-airplane communications for idle chitchat among pilots. Airplanes are easy to tune in. You can think of the planes' antennas as the largest tower around—the signal really gets out from several thousand feet up in the sky!

If you live near an airport, you might also hear the tower giving flight clearance to various aircraft. At smaller airports, airplanes may be communicating with a distant "center" to get their flight approved. If your scanner is equipped with the 225 to 400 MHz band (and only top-of-the-line scanners are), it will tune a variety of services, but primarily military aircraft and satellites. The military aircraft use the AM mode, while most of the military satellites that show up here use the "narrow FM" mode. If you snag one of these satellites, you'll often hear tactical communications among various military posts.

Types of Scanners

There are three basic types of scanners: handheld, mobile, and base. If you're on the go a lot, a handheld scanner might be the best bet, especially if you want to know what's going on around you at all times.

Handheld scanners typically can fit in a pocket or purse or will clip to a belt. A NiCd battery with a recharging pack allows you to use the scanner for several hours before recharging it (typically overnight). A handheld scanner is convenient because it can be used at home, in your office, in your car, and even while you're shopping (although some

shoppers might be convinced you're a store security guard with the radio clipped to your hip!). The main drawback with a handheld scanner is its battery life. But, if you only listen for a few hours each day, and do it on the move, the handheld scanner is the way to go.

If you want to be informed while driving, perhaps a mobile scanner is preferable. The scanner can be mounted under your dashboard and run off the car battery. With an outside antenna, either a magnetic mount or permanently mounted, you can hear all around you. Let's say a police car speeds by, you can monitor the department's frequency to know what's going on, and better yet, you can anticipate traffic delays ahead of time. For instance, if you hear police and fire units being dispatched to a major intersection that's along your travel route, you can reroute yourself before you approach the scene and avoid getting stuck in a line of backed-up traffic. I know it's kept me out of many jams!

Scanning fire department frequencies proves exciting listening. This is Fairfax County Fire and Rescue Station 34 in Oakton, VA. The station also houses a hazardous materials response team. (Photo by Ken Fowler.)

You may even hear that police are looking for a specific vehicle involved in a crime; then you, too, can keep a look out and give the police an extra set of eyes. If you spot the vehicle or suspect sought by police, you can alert them from a cellular or pay phone. You'd be surprised at the number of people apprehended on tips from scanner listeners!

One thing we also should mention is that some states or cities may restrict the use of scanners in vehicles by private citizens. Again, be sure to check with the store sales personnel or your local police department before installing a scanner in your car. Know also that many states exempt licensed ham radio operators from mobile scanner laws. That in itself might be an incentive for you to get a ham license to cover your mobile scanning if your state restricts such use.

The third type of scanner, the base scanner, is designed to be used in your home or place of work. Some scanners, such as the Radio Shack's PRO- 2006 are designed for in-home use and have sturdy features that allow them to be set up on a desk or table top for lots of scanning action. Also, a lot of mobile scanners come equipped with an AC converter that allows them to be plugged into an outlet in your home. The converter changes your home's 120 volts AC to the radio's needed 12 volts DC.

A Union Pacific Railroad worker switches track while staying in touch with crews with his handheld radio in his back pocket. A speaker-microphone eases operation. (Photo courtesy Union Pacific System.)

Antennas

Unless you're buying a handheld scanner, you probably should consider purchasing a good scanner antenna, too. Normally, the rubber antenna (actually it's a wound wire covered with rubber) on a handheld scanner will prove satisfactory as you move around. The only exception is that you might want to connect a mobile scanner antenna while you use the handheld in your car to increase your reception range.

For mobile installations, you'll need a scanner antenna mounted on the outside of your vehicle. Typical types of mobile antennas include those permanently mounted on the roof, a trunk-lid mount with set screws, a magnetic mount, or even an on-glass mount. The magnetic mount is popular because the antenna can be hidden in the car while in parking lots so you don't advertise to thieves that there's a scanner inside.

Base antennas can take pretty much any form you want. If you listen primarily to the routine 30-50, 150-174 and 450-512 MHz scanner bands, an antenna designed for those bands with gain to amplify the signal will work best. The signal typically will be amplified in a coil on the base or middle of the antenna. The trick with base antennas is to get them as high as possible because of the line-of-sight nature of VHF and UHF communications. On that premise, if you can "see" the station transmitting, you also can hear the signal.

One popular type of base scanning antenna is the discone. While it does not have any gain, it does offer wide frequency coverage, typically 40 to 900 MHz. This is a good bet if you like listening to not only the normal scanner bands, but also, for instance, the military aircraft band at 225-400 MHz. By sacrificing gain on any given band, you are getting an

antenna that covers all frequencies inclusively, instead of only certain designated segments.

Another trick for scanner listeners is to use ham antennas. If most of your scanner listening is in the 144-174 MHz band, try using a ham antenna designed for the 2-meter ham band at 144-148 MHz. It will work really well on VHF high band (144-174 MHz) and will offer acceptable performance on UHF, too.

When choosing a place to mount your scanner antenna, try to minimize the length of cable that will be running to the radio. The best bet is to use a cable that exhibits low-loss characteristics so most of your signal isn't "lost" in the cable before it even gets to the scanner from your antenna. Belden 9913, or an equivalent, has proven popular with serious scanner listeners.

If you only want to know what's going on around your neighborhood, by all means, don't go to great lengths to put up a good antenna. If the neighborhood is your only concern, the telescoping whip supplied with your scanner will prove quite satisfactory.

Join a club

If you want to explore the hobby of scanning with others, you might consider joining a club devoted to scanner listening. Most clubs publish monthly or semi-monthly newsletters to keep members up to date on scanner activity in their area. The newsletters typically publish frequencies, radio code lists, and mobile unit number identifier lists, listening tips and more. Here are a few clubs to check out to help you on your way (enclose a self-addressed, stamped envelope for a reply). Good luck and good listening. ■

Scanner Clubs

- Radio Communications Monitoring Association, P.O. Box 542, Silverado, CA 92676. (Covers all states, Canada and even has an international column.)
- All Ohio Scanner Club, 50 Villa Road, Springfield, OH 45503. (Covers Ohio and all surrounding states.)
- Northeast Scanners, P.O. Box 62, Gibbstown, NJ 08027. (Covers Maine to Virginia.)
- Bay Area Scanner Enthusiasts, 105 Sierra Way, Apt. 363, Milpitas, CA 95035. (Covers western United States.)
- Capitol Hill Monitors, Alan Henney, 6912 Prince Georges Ave., Takoma Park, MD 20912-5414. (Covers Washington, D.C., Maryland, northern Virginia, southern Delaware.)
- Chicago Area Radio Monitoring Association, Ted and Kim Moran, 6536 N. Francisco, Apt. 3E, Chicago, IL 60645. (Covers Chicago area and all of Illinois and surrounding states.)
- SCAN-Iowa, P.O. Box 911-RS, Burlington, IA 52601-0911. (Covers all of Iowa and surrounding states.)

Glossary

AM—Amplitude modulation, a form of sending the signal from the station. Typically used by AM radio stations, aircraft, CB and military aircraft.

Base—A radio operated from a permanent location, such as a home or office.

Crystal—A plug-in module formerly used in scanners to determine what frequencies it would scan.

Dispatch—The act of sending patrol cars, firefighters, etc., to locations where they are needed.

F2—Short for Frequency 2 (also may be referred to as Channel 2). Two-way radio users use these designators when switching frequencies for communicating.

FM—Frequency modulation, another form of sending the signal from the station. Typically used by all two-way radio users.

Frequency Guide—A book of frequencies for a given geographic region.

Hams—Amateur radio operators who have passed a test and hold an FCC license for hobby communications on a variety of bands.

Listening Post—Wherever a radio hobbyist sets up shop to listen to the radio; it might be a desk, a table top, or even an entire room.

MHz—Megahertz, what scanner frequencies are measured in.

Mobile—A radio installed in a motor vehicle for either transmitting or receiving.

Programmable Scanner—A scanner that receives frequencies through a synthesizer that allows any frequency to be programmed within certain band limits.

Remote Broadcasts—Radio stations transmitting from outside the studio are conducting a remote broadcast, such as news reports, sporting events, etc.

Scanner—A receiver that scans through multiple frequencies in the VHF and UHF bands, stopping on a channel when it hears communications in progress and resuming scanning when the message is over.

Search—The capability of a scanner to scan through all frequencies between two designated frequencies, searching for any communications in progress.

Studio-to-Transmitter Links—Frequencies used by radio stations to feed programming from their studio to a remotely located tower site for broadcast.

UHF Scanner Bands—Technically all frequencies from 300 to 3000 MHz, but typically from 406 to 512 MHz.

VHF High Band—Typically the VHF scanner bands from 137 to 174 MHz.

VHF Low Band—Typically the VHF scanner band from 25 to 50 MHz.

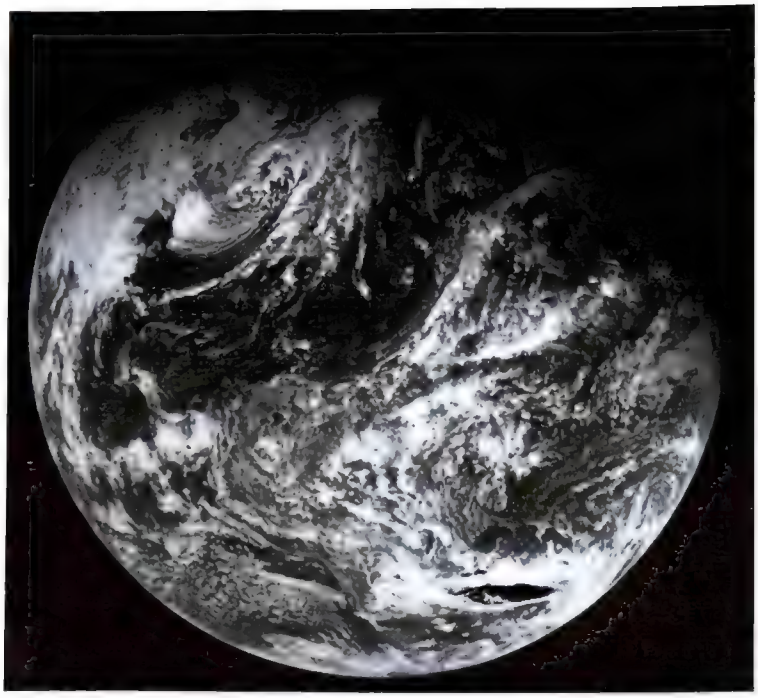
VHF Marine—A band of frequencies between 156 and 162 MHz used by boats and vessels on lakes, rivers and oceans.

You Can Hear *WHAT* On A Scanner?

Believe it or not, satellites, space stations, and orbiting space vehicles are within earshot.

By Donald E. Dickerson, N9CUE

Most scanners are capable of tuning some *very* interesting signals from space. For instance, did you know that you can use your scanner to tune low-orbiting satellites, the U.S. Space Shuttle or the Russian space station, MIR? Just imagine the voice of a Russian cosmonaut coming from your speaker, direct from space! Or, if you are lucky enough to live near a NASA facility, like Kennedy, Johnson or Edwards Air Force Base (or if you take a handheld scanner to one of these facilities while on vacation!), it will prove to be a feeding frenzy for your ears. Not



From your home station you can hear satellites, the Space Shuttle and even the Russian spacecraft, MIR. (NASA Photo)

The Space Shuttle blasts off from Cape Kennedy. (NASA Photo)

only will you be able to listen to the shuttle on launch and landing, but you will can also monitor security operations, support aircraft, U.S. Coast Guard ships retrieving fuel tanks, chase planes, launch platform crews, NASA operations center, and landing crews!.

So whether you're a first-time owner of a new scanner or an old salt at tuning the radio spectrum who wants to try something new, here are some things to consider.

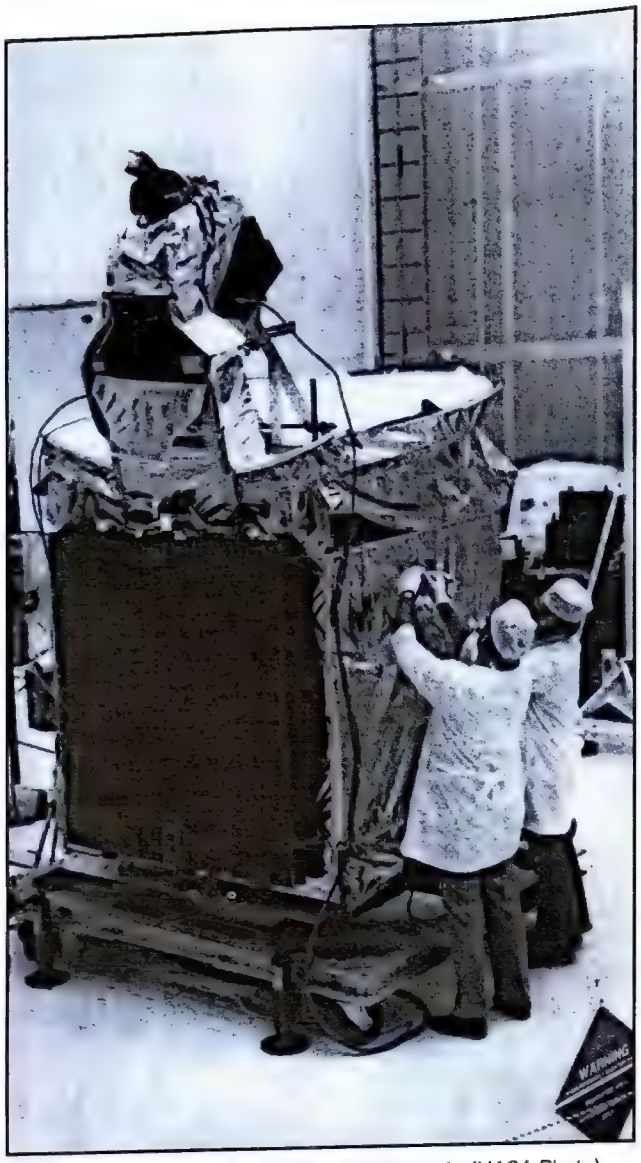
Voices from Space

The first thing you need to know is where to look for these exotic space signals. What frequency do satellites and space stations use?

Let's start by looking at voice channels used by U.S. and Russian space travelers. The first frequency you want to put in your scanner's memory is 145.550 MHz. It is on this frequency that both nations operate amateur radio stations from their spacecraft. This frequency is in the 2-meter amateur band and is received by most scanners. Your scanner specifications will list a frequency band of 134-174 or 118-174 MHz unless, of course, yours is a continuous coverage scanner, which means it's capable of tuning an entire range of frequencies—certainly 145.550 MHz! The transmission mode will be FM. In this case, as with public safety stations, narrow-band FM (NBFM) is used. Your scanner will also be capable of tuning wideband FM (WBFM), used by UHF and 800 MHz radio systems and Russian spacecraft. Amplitude modulation (AM) is used exclusively by aircraft in the 118-137 MHz band.

Monitoring 145.550 MHz will allow you to hear any voice communications from the shuttle or MIR while they are over your location. Astronauts who are amateur radio operators use this frequency in their spare time or during regularly scheduled experiments for NASA. This same frequency is the main downlink for packet transmissions. This is an amateur data format that both the shuttle and MIR space station use in addition to voice mode. They also experiment with TV transmissions.

The MIR and its manned transport vehicle "Soyuz" use frequencies similar to 145 MHz. MIR VHF voice channels are 143.625, 142.217, and 121.750 MHz. Until the recent launch of a satellite system similar to our own TDRS (Technical Data & Tracking Relay Satellites), which relays communications directly to a central ground station, Moscow had to depend on the 143.625 MHz frequency for all its voice transmissions with MIR. There were ground stations throughout the former Soviet Union and a special fleet of ships at sea that would relay the signal to a waiting satellite (Molniya) for relay to Moscow. Now, with the breakup of the USSR, newly independent countries are asking outrageous fees for using stations that are now theirs. Possession, they say, is nine-tenths of the law, even in the former USSR! Because of this, the 143.625 and 145.550 MHz frequencies are still very much in use. Moscow is even using the packet (data) transmission on the amateur frequency to send lengthy daily instructions for operation of the space station. The 142.417 and 121.750 MHz frequencies have been used for docking the Soyuz transport vehicles to the space station. These transmissions are in WBFM. You won't need to know



An RCA SATCOM being readied for launch. (NASA Photo)

Russian to know when you catch one of their transmissions, so be sure to load these frequencies in your scanner.

Russian Amateur Radio in Space

In 1991, the Russians placed the first FM amateur radio satellite in orbit. The spacecraft is identified as RS-14: the RS stands for Radio Satellite (Sputnik) and the 14 indicates that it is the 14th spacecraft in the series. RS-14 is actually a packet data satellite. Its single-channel FM transponder (a combination of a receiver for one band and a transmitter for another band) can be heard on 145.987 MHz. Here you will find amateur radio operators making contacts throughout the U.S. as well as pre-recorded voice transmissions about the peaceful use of space. RS-14 will, for example, receive signals uplinked to it from the ground on the 435 MHz band and will simultaneously transmit this same signal down to earth (or downlink) on the 145 MHz band. In this case, the FM uplink for RS-14 is 435.016 MHz and the downlink is 145.987 MHz. FM signals are very wide (usually 15–30 kHz)

Here's plenty of frequency information to get you started in scanning.

Known FM Military Satellite Channels (MHz)

248.900	261.650	262.275	269.175
249.550	261.675	262.300	269.550
260.475	261.700	262.475	269.850
260.600	261.900	262.550	269.950
260.975	261.950	262.675	288.000
261.450	262.050	262.950	295.075
261.500	262.100	264.900	
261.600	262.150	269.075	

NASA Facilities (MHz)

Marshall (Alabama)	170.100
122.850	173.685
162.125	314.600
164.175	382.600
166.225	Goddard (Maryland)
168.450	164.175
314.600	167.825
Johnson (Texas)	170.400
164.050	171.150
168.000	

Kennedy Space Center (MHz)

Operations	165.190	126.300	Ships
121.900	171.260	126.400	141.000
126.400	273.500	138.300	148.455
139.300	Aircraft	148.500	148.500
140.200	117.800	273.000	149.000
142.800	118.400	335.800	149.100
148.400	120.950		162.000
162.600	121.500		

Dryden/Edwards AFB (MHz)

Operations	126.100
138.175	127.800
139.800	149.100
148.675	Shuttle Launch/Landing
170.350	121.750
228.200	123.600
259.700	126.300
Aircraft	284.000
116.400	296.000
120.950	296.800
121.800	

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and are not an efficient use of frequency space, especially on a satellite's narrow transponder. For this reason, RS-14 has only one channel for FM, which allows only one station to use it at a time. Single-sideband (SSB) or Morse code (CW) is the usual transmission mode for amateur satellites. Several SSB or CW stations can operate simultaneously on a transponder wide enough for only one FM signal.

If your scanner includes an SSB reception mode, you have several other options. With the proper antenna and pre-amp, you can listen to amateur conversations over the OSCAR 10 or 13 satellites. They downlink signals in the 145 and 435 MHz bands. Their signals tend to be weaker because of the higher orbit they maintain. But, before we move into other transmission modes and away from FM, let's look at another possible source of FM from space.

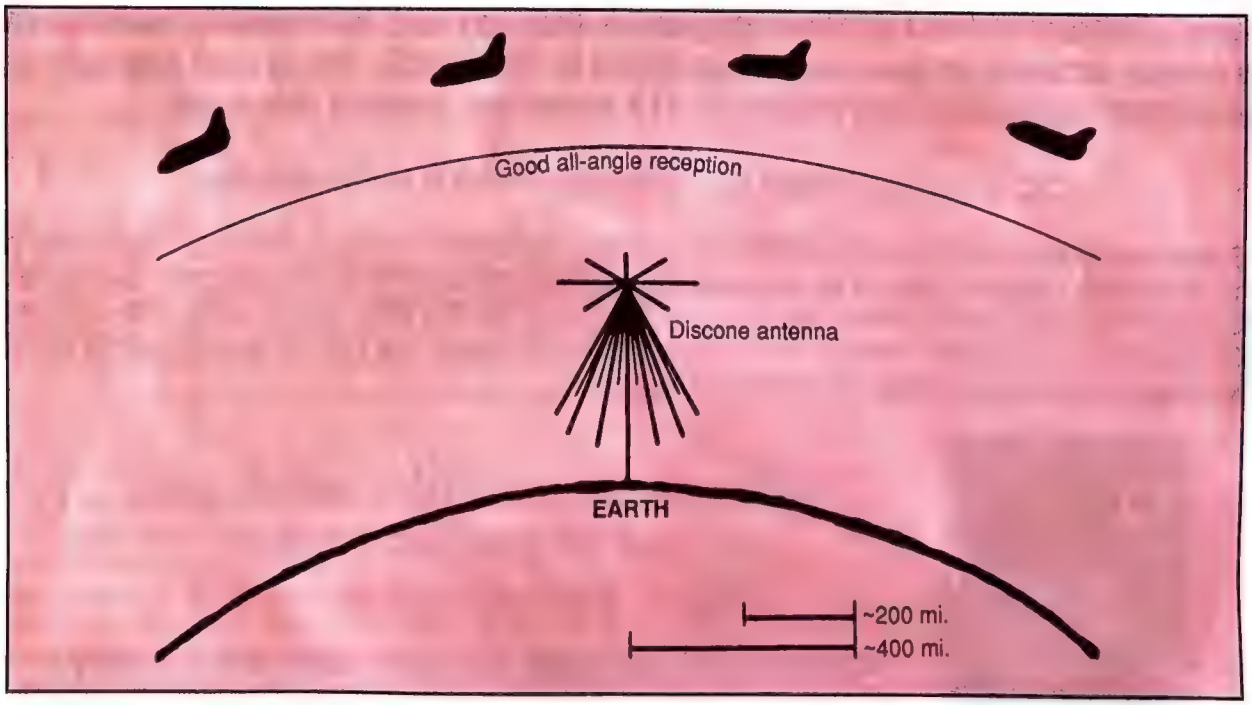
Geo-Stationary and Low-Orbiting Satellites

The military operates several networks of geo-stationary satellites. These spacecraft are 22,000 miles above the earth, mixed in among the TV and telecommunication satellites. You can, on occasion, find an open FM voice channel being used on these satellites. These channels are clustered around 260 MHz in the military band (225-400 MHz). Listening for them will require a discone and pre-amp or a beam antenna that allows you to control both azimuth and elevation.

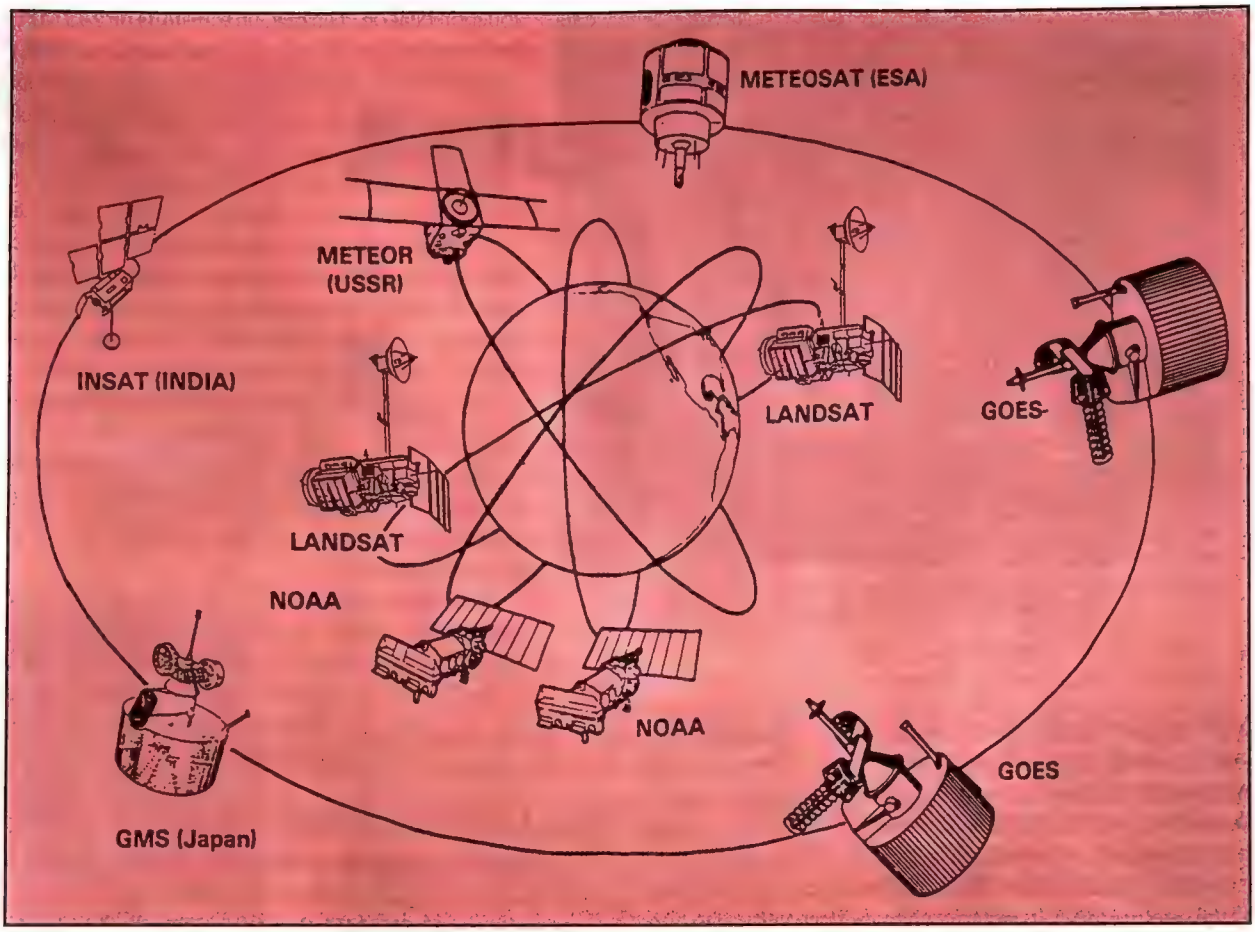
Virtually any scanner you buy will offer the 108 to 174 MHz band (some offer 134 to 174 MHz). This lets you listen to the FM from manned space missions and allows you to tune the 136-138 MHz satellite band. This is where the polar orbiting (low altitude) weather and experimental satellites can be heard. All you will hear on this band are the various sounds of data transmissions from these spacecraft. Many hobbyists move into this band with a computer, modem, and computer program to intercept and print their own weather satellite photos. Others use this band to track satellites, usually by computer. You can still track the spacecraft with a manual tracking device if you receive the necessary tracking data from NASA. Some students of this band are rewarded by being the first to hear and report a new spacecraft transmitting. The band will also be the new home of the Low Orbit Mobile Satellite Service.

One other note on tracking. Some folks like to visually spot satellites. By tracking them you will know when their orbit will bring them over your location, near or just after sunset and just before dawn. At this point, the spacecraft will still be in direct sunlight while your sky is dark. It is easy to spot fast moving spacecraft under such conditions.

The manned spacecraft frequencies in the 143 and 145 MHz bands also fall into this 108 to 174 MHz section. VHF (30 to 300 MHz) and UHF (300 to 3,000 MHz) are considered line-of-sight frequencies. That is, they are usually only good for short range communications. Since these frequency bands are usually used in a land mobile radio system, such as police and fire services, the range is usually limited to 20 miles. This limitation is caused by the obstacles and terrain that come between the base and mobile antenna. This difficulty is completely eliminated in space. As long as the spacecraft you want to hear is above your horizon, you will have line-of-sight, whether the target is 200 or 1,200 miles aloft. While the spacecraft is above your horizon, you will hear any voice signal it transmits on the channels you are monitoring. You don't need an outside antenna to punch in the



A discone antenna will provide good all-angle reception of orbiting vehicles.



Operational Earth Observation Satellites

frequencies to listen, but you will want one eventually, as it will improve signal strength and increase the time you have a usable signal during each pass. Spacecraft that are 200 to 1,200 miles up (above your horizon) will be in range of your station between eight to 15 minutes per pass. In the case of amateur satellites, it takes approximately 90 minutes to complete an orbit. During this time, the earth will have turned approximately 30 degrees beneath the spacecraft. This is important tracking information and shows that the satellite will make two or three consecutive crossings of the U.S. during the day.

Equipment for Satellite Listening

I use and highly recommend the discone antenna for several reasons (the Radio Shack 20-013 is particularly good). First, it is a vertically polarized antenna, but has elements in both vertical and horizontal plane. The antenna has a series of drooping ground radials and a flat disc-like top hat. The horizontal elements are great at catching high-angle signals from spacecraft, even when the craft is directly overhead. Another advantage of a discone for space operations is that it is wide-banded, usually providing good performance over a wide frequency range. The discone is also a unity gain antenna. This is important if you live in an RF saturated area. This is where heavy VHF/UHF radio activity is present, as in most major cities. A scanner can overload and have other image and interference problems in such an area even without an outside antenna. A discone will not add as much gain as some other antennas. In rural or suburban areas, high gain and even beam antennas will also work well.

A vertical antenna has good gain and is designed primarily for signals arriving at low angles, like mobile units and other base radio stations. This can be a small disadvantage when listening to spacecraft. As the satellite climbs in altitude and the radio signal arrives at the antenna at a higher and higher angle, there is less capture area available to receive the signal, thereby limiting signal strength. As the spacecraft descends toward the horizon, it again enters the vertical's low angle reception area. Near the horizon is where the vertical will exceed the discone's performance.

The higher you go in frequency, the greater loss in your antenna line and connectors. So, use the best quality equipment you can afford. Your solder connections should be good, too.

If you are interested in listening to the voice signals on amateur radio satellites, you will need a scanning receiver that has selectable upper sideband and lower sideband controls. Also, if you plan on moving into some of the data modes, like weather fax, packet, etc., a quality, stable receiver with good filtering will be required. This will allow you to hear SSB voice/CW (and data) on the 29, 145, and 435

The Radio Shack PRO-2006 scanner is your ticket to listening to a multitude of space communications and much more!

MHz amateur bands. An outside antenna will be required to hear the satellites at 435 MHz and above. Some amateurs who use the high altitude Oscar-type satellites use a twist antenna to compensate for the movement of the spacecraft, which can produce deep fades in the signal. This is most often caused by the stationary dipole antenna used by the satellite: as the satellite turns, its polarity changes from vertical to horizontal (relatively speaking). You can put together a simple two-element twist antenna that will work for weather, amateur, and manned satellites, as well as for the military band. It has the same advantages of a discone antenna and can be placed in the attic. If you are going to listen in on only one satellite band or frequency, you can cut the antenna for that specific frequency; if it is cut for the lowest frequency used, it will work well as an all-around antenna. You can find complete instructions on building this antenna in *The Weather Satellite Handbook*, by Ralph Taggart (see information box at end of article).

To listen in on military satellites, you only need a scanner that tunes the 225 to 400 MHz spectrum and a discone or yagi beam antenna that you can point at the satellite. A single band or wideband pre-amp will help, but it's not a top priority for the newcomer. Also remember to keep your high-quality feed lines as short as possible on any installation.

Tuning Extra Vehicular Activity

There is one other exotic source of space listening you may wish to pursue. During space shuttle missions, astronauts will sometimes leave the spacecraft to make repairs or conduct an experiment. These space walks are officially known as Extra Vehicular Activity, or EVAs. When outside the spacecraft, astronauts use a full duplex set of VHF frequencies to maintain radio contact with the shuttle. Each self-propelled EVA manpack has three voice channels and an emergency location beacon. The beacon transmits on 243 MHz in an emergency. The duplex frequencies are 259.7 and 296.8 MHz. Full duplex simply means that both parties can talk at the same time and be heard, much like telephone conversations. For example, if the shuttle transmits on 259.7 MHz, it will listen on 296.8 MHz. The EVA pack will then transmit on 296.8 MHz and listen for the shuttle on 259.7 MHz. There is an additional frequency on the EVA pack that the shuttle cannot hear. It is a direct frequency between EVA packs and is on 279.0 MHz. These VHF voice frequencies have their audio fed into a relay transmitter aboard the shuttle that simultaneously transmits the communications to the TDRS, which was specifically designed to relay shuttle communications. It uses the S-band (2,000 to 4,000 MHz or 2 to 4 GHz) to relay communications to ground stations.

Don't forget that the EVA frequencies are in the middle of the military aero band and not all scanners include this band. The duplex frequencies used on the EVA packs are much like other VHF signals: they are line-of-sight and will be within range of your location when they are above your horizon.

One Last Reminder

When you are putting frequencies into your new scanner, it may automatically round off the frequency. For example, you may enter 142.417 MHz in memory, only to have the readout display 143.415 MHz, or 145.987 MHz will show as 145.985 MHz. This will not affect your receiver's ability to hear stations, however, as the receiver will allow signals that are several kHz from the center frequency to be heard without difficulty.

As we as we rocket toward the year 2001, why not give your scanner some new numbers to crunch and get in on the cutting edge of communications. Plug in some space frequencies and try your luck. Remember, patience is a virtue, and you'll need it when searching the blackness of space for exotic radio signals. Don't be disappointed if you don't hear the Russian MIR space station on your first try—just keep trying. There is little to compare to the thrill of hearing your first voice transmissions from U.S. astronauts or Russian cosmonauts transmitting directly from space into your home. Your patience will be well rewarded.

For a detailed look at NASA communications and an exhaustive NASA frequency list, I suggest a book called *Monitoring NASA Communications* by Tony Curtis, K3RXK. It's carried by most mail order companies or you can write to Tiare Publications, P.O. Box 493, Lake Geneva, WI 53147. Good listening!

For detailed instructions on building your own antenna check out *The Weather Satellite Handbook* by Ralph Taggert, published by the ARRL, Newington, CT.

One Size Fits All!

Amateur Radio

If you want to get in on the fun and excitement of personal radio communications—from talking to friends across town, to making new friends in dozens of foreign countries—Amateur Radio is for you!

More than two million people around the world share a fascination with the diversity and friendships Amateur Radio brings to their lives. Amateur Radio is a multifaceted method of communication that fits every lifestyle.

Who are these Amateur Radio enthusiasts? Kings, country western singing stars, senior citizens, astronauts, school children, mechanics and homemakers, to name just a few. Anyone can enjoy Amateur Radio, regardless of age, gender, occupation or physical ability.

The best part about Amateur Radio is that there are so many activities to explore—finding your perfect fit is half of the fun. You can operate a two-way radio station from your easy-chair, computer, car, boar, camper or even from a mountaintop! It's two-way mobility with a capital "M."

Amateur Radio is fun and convenient—and it's great for emergencies. You can talk to other hams (Amateur Radio operators) across town, across the globe and even beyond. Ever imagine talking to an astronaut in orbit or bouncing a signal off the moon and back? Amateur Radio operators do it every day—and you can, too.

Finding out how you can get started in ham radio couldn't be easier. We're the American Radio Relay League, the largest Amateur Radio membership organization in the country, and we've been helping hams (and future hams) get started for more than 75 years. We'll help you, too.

A great way to get more acquainted with Amateur Radio, or enhance your ham radio enjoyment if you're already licensed, is membership in the ARRL. In addition to invaluable services, benefits and access to dozens of specialized ham radio books, each month you'll receive your membership journal, *QST*. Weighing in at more than 200 pages per issue, *QST* is packed with Amateur Radio news, features, operating tips, technical advice *and* a very special section for beginners: *New Ham Companion*. You'll get the whole picture—everything that's going on in the amateur community, and you'll be able to take advantage of everything Amateur Radio has to offer.

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Getting started in Amateur Radio is as simple as calling the toll-free number shown below.

The easiest way to get the "ball rolling" is to ask for our free "Getting Started in Amateur Radio" package. Included is all the information you need to find out about how you can get on the air with your own ham radio station.

If you're already a ham—or think that you want to be!—call the toll-free number and sign up for a 1-year ARRL Membership. Membership in the American Radio Relay League—the national organization of Amateur Radio operators—is an invaluable help in getting a good start in ham radio. As an ARRL Member, you'll expand your Amateur Radio horizons with expert information on virtually every Amateur Radio topic and enjoy membership services tailored to your needs as a new ham.

So, what are you waiting for? Call today. The fascinating world of Amateur Radio awaits!

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In Review: The Radio Shack PRO-2006 Scanner

By Harold Ort, N2RLL

The PRO-2006 covers virtually the entire VHF/UHF spectrum.

There was a time when "programming the scanner" meant going down to the local Radio Shack store to buy frequency crystals. Fact is, there were times when the exact frequency you needed wasn't even in stock. Well, you probably needed some extra coax or flashlight batteries anyway. There was also a time when most public service agencies like police, fire and medical services, were found in the lower VHF range. Ah, yes, those were the days, right? Wrong!

With only a handful of available crystal slots, scanner users could only dream of some future time when dozens, perhaps hundreds, of frequencies could somehow be jammed inside a futuristic listening device. You'd want superb sensitivity and selectivity, a receiver that would scan through your channels in the blink of an eye, and cover virtually the entire VHF/UHF spectrum, and then some. You'd want the Radio Shack PRO-2006.

The PRO-2006 has been acclaimed by many serious monitors and experts as a top-of-the-line scanner. Bill Cheek, writing in *Popular Communications* magazine said, "The [Radio Shack] PRO-2006 continues the fine tradition of excellence at an affordable price. . . ." I certainly agree with Bill. Having owned this particular scanner for three years now, it's the best investment in a scanner I've ever made. We live in an area that's super-saturated with paging, cellular, taxicab, police and fire transmitters. The PRO-2006 performs like a gem, hearing signals from remote mobiles with only an outside discone antenna, and rejecting out-of-band signals and nearby strong transmissions!

Let's Open The Box

Open the carton and look at the easy-to-understand manual. Here's a manual that needs no further explanation or frantic calls to a manufacturer to decipher its contents. It's in plain English with plenty of illustrations to guide first-time buyers (and experienced scanner users, too) through every facet of its operation. There's always the temptation to operate radios without looking at the manual, but do it right. Read the manual and keep it in a drawer near the scanner; you never know when you'll have a question—and believe me, this manual answers all your questions!

Frequency Coverage

Let's talk a minute about the PRO-2006's frequency coverage. It tunes 25 to 520, 760 to 823, 851 to 868, and 896 to 1300 MHz. That's a hefty portion of the scanning radio spectrum! There's CB, police, medical, fire, satellites, aircraft (both commercial and military bands), marine, railroad, weather, amateur (ham) and government frequency coverage. Upon careful examination of the coverage, you'll notice the scanner doesn't tune the cellular telephone frequencies. This is no big loss to most users, though, since it does include the new 800 MHz public safety frequencies.

Ease of Operation

It's important to be able to see the scanner's multi-purpose LCD window clearly. Radio Shack has thoughtfully provided two front-mounted folding feet that tilt the unit up for an excellent viewing angle. Of course they can be left in the down position, if desired.

The keyboard of the PRO-2006 is extremely user-friendly. Besides the rotary volume (on/off) and squelch controls, the actual push-button operation is broken down into two sections: "Operation" and "Program." You can see that a lot of common sense went into the layout of the keyboard. The 10 number keys on the "Program" side of the scanner also have white imprinted numbers above each key, indicating the channel numbers found in each "bank." (We'll talk more about banks in a minute). All the buttons have a professional feel to them when pushed. Unlike some scanners, they don't rock back and forth as if mounted on the end of a needle, rather it feels firm and responsive.

The PRO-2006 operates from standard 110 VAC house current or with an optional power cable (Radio Shack number 270-1534), from your vehicle cigarette lighter socket. If you're interested in mobile monitoring, go to your local Radio Shack store and have them order part number 20-0001 "Quick Release Mounting Bracket" (20-127/144/145). It's currently $24.99 plus $4 shipping directly to your home. (Please realize, however, that in some areas it's illegal to use a scanner in a vehicle—make sure you know the local laws before making a purchase.)

Let's quickly highlight how easy it is to program a known frequency into the PRO-2006. Using the front panel keyboard, you'd first press MANUAL, then PROGRAM, followed by the frequency digits, and then pressing ENTER. The multi-purpose lighted display window prompts you with messages as reminders of the mode you're in, such as "program," which alerts you that you're in the "program" mode, or "delay" which tells you you've entered a two-second delay in the memory for a particular channel. (The delay feature pauses the scan function after each received transmission, giving you a chance to hear the other person's response.) The PRO-2006 scans at 26 and 13 channels per second. That means that in about 15 seconds all 400 channels are scanned. That's lightning fast! A simple key press switches between the two speeds.

All in all, the 2006 can store up to 410 frequencies. It works like this. This state-of-the-art machine has 400 permanent memories, or channels, plus 10 "monitor" memories. The 400 channels are divided into 10 groups (banks) of 40 channels each. Serious listeners find that grouping of specific types of services is extremely useful. For example, you can program Bank 1 (channels 1-40) with your local police, sheriff, and nearby town police frequencies. In Bank 2 (channels 41-80) you might want to program your ambulance, emergency medical, and related services. In each of the remaining eight banks you can program 40 aircraft frequencies, 40 military/federal frequencies, etc., up to a total of 400 channels. You can scan all 400 channels, or tell the scanner which particular banks you want to hear. For instance, if you want to hear only your local police and sheriff frequencies (Bank 1) you simply turn on that bank by pressing the "1" key for the bank you want to turn on (or off). In the display, if the "bank" indicator is on, a small bar will appear under the bank number, indicating that bank is being scanned. You can scan all 10 banks or only one. You decide!

If you've got a favorite channel you want to keep constant tabs on, program it in the 2006's priority channel. Unlike some scanners, the priority channel doesn't have to be Channel 1; you can designate any of the 400 channels your priority channel. Simply press the PROGRAM key and the desired channel number, then press the PRI key. Again, the display cues you by displaying "P" when the scanner is set to the priority channel.

You can also lockout (or skip) those channels you don't want the 2006 to scan. While this is a common feature on scanners, this unit takes it a step further by including a "lockout review." This unique feature allows you to visually check those channels you've locked out. Very often, folks frequently lock out a channel or two, only to use the scanner a few days later forgetting that they went "lockout crazy" and that now maybe a dozen or more frequencies are locked out. The simple remedy is to use the "lockout review" feature of the 2006 by pressing L/O RVW. To subsequently unlock a locked out channel, press LOCKOUT.

One of the tradeoffs made when technology made the giant leap from crystal-controlled scanners to the programmable type resulted in an annoyance called "birdies." These are signals generated inside your scanner that fool it into "thinking" it's hearing a transmission when, in fact, it isn't. This is a common occurrence in scanners, but thankfully the PRO-2006 is virtually immune to birdies. For the few birdies and other signals you may encounter in your area without any sound—just an unmodulated carrier—the 2006 incorporates a "sound squelch" circuit. This is one of the single most useful items around. Push the button in activating the sound squelch, and, when the scanner hears a transmission with no sound within 1/2 second, it goes to the next transmission.

Search and Monitor Functions

If you're like most listeners, you'll want to set up the 10 search banks for small segments of particular frequency bands. Take the 406 to 420 MHz government band, for example. You'd never search such a large segment of frequencies. Instead, pick a smaller portion, say 406 to 408 MHz to search. With the PRO-2006, as the scanner detects a transmission and stops during its search, you can store that new frequency in a "monitor" channel. This stores the frequency in one of 10 channels for future listening. Later you can listen to those stored monitor memories. If you decide to store the new frequency in one of the 400 main channels, the 2006 allows you to easily transfer your catches by a few simple button pushes.

More Than A Scanner

The PRO-2006 is much more than a scanner: it's a scanning receiver with lots of great additions to make your listening more enjoyable. The list of features includes a telescoping whip antenna that screws into the top of the unit. (Use this for close-in reception of nearby transmissions, but for best results connect a properly-mounted discone antenna either outside or in your attic, if possible.) It also offers jacks on the rear panel for an external speaker (although the audio output of 1.3 watts is enough to easily reach from my listening post to the next room!), a tape recorder output and 13.8 VDC jack for mobile operation. There's even a headphone jack on the front panel. I'd recommend the Radio Shack 20-210 mono headset. The 2006 weighs about five pounds and measures about (HWD) 3" X 8" X 8".

If you're thinking about a scanner you can use at home or when you're mobile and that has a whopping 400 channels, plenty of extra features and 800 MHz coverage, think no further than the PRO-2006 for $399.99. The key word in the 2006 is "PRO"! ■

Shortwave: The Great Radio Escape

Here's your "Shortwave-101" course. We'll tell you what you can hear, and much, much more.

By Gerry L. Dexter

Hold down the scan button on your digital AM radio. You'll find it stops when it hits 1600 or 1610, if it doesn't revert back to the beginning of the AM band. If you could somehow force those numbers to go higher—past 1700 kHz, past 2000 and beyond, you'd find yourself in a very different radio world. It's a place filled with all kinds of strange sounds, unusual music, information you didn't find on that AM dial, not to mention mysterious signals and other listening adventures.

Fortunately, it doesn't matter much that your ordinary AM radio won't let you explore this Tolkien-like land. An inexpensive to moderately priced shortwave radio (and some patience) is all it takes!

The Shortwave Difference

Shortwave picks up where the AM radio band leaves off. It is just one slice of the huge electromagnetic spectrum, but it's a pretty big one. It covers an area about 25 times larger than the space on your ordinary AM radio. In other words, if AM is Delaware, then shortwave is Texas! Shortwave radio picks up at 1,700 kHz where AM radio ends (an international agreement recently moved the upper border of the band from 1,605) and runs all the way up to 30,000 kHz.

Shortwave frequencies are given in kiloHertz (kHz) or MegaHertz (MHz). A MegaHertz is the equivalent of 1,000 kHz, a frequency which is right in the middle of the AM band. There are a lot of frequency references dealing with shortwave, and it's easier to say or write 30 MHz instead of 30,000 kHz. You will also encounter the terms "meters" and "meter band." While kiloHertz and MegaHertz are measurements of how many radio waves are produced by a transmitter in a given second (i.e., the frequency of the waves), meters measure the distance between each of the waves. Meter band is a more general classification for many frequencies having the same approximate wavelength. The 31-meter band, for instance, refers to the group of frequencies with wavelengths of 31 point something meters. (Sometimes it's even less specific.)

A discussion program goes out to a worldwide audience from Deutsche Welle, The Voice of Germany.

Propagation—Getting a Signal from Here to There

Propagation is the natural force which enables a signal to get from one point to another, and it's essential to every kind of radio transmission. But shortwave is even more dependent on propagation than any other group of frequencies. Propagation on the shortwave bands is especially temperamental, and many elements affect shortwave reception. The

Listeners hear an announcement over the Ghana Broadcasting Corporation, a station often audible around 0600 on 4915 kHz.

A disc jockey on the Solomon Islands Broadcasting Service. A good receiver and antenna can usually pick up this station in the summer months around 0700 on 9545 kHz.

time of day versus the frequency band to which you are listening, the season of the year, and the state of the sunspot cycle are all determining factors in shortwave reception. Sudden bursts from the sun can even wipe out shortwave reception for several hours.

This means shortwave is not quite as dependable a medium as AM or FM. You can't always be 100% sure the station you want will always be there, or, if it is, that it will be as loud and clear as your favorite AM or FM broadcast station. For many shortwave listeners (also called SWLs) though, that somewhat uncertain situation is part of the fun of shortwave.

What Can You Hear?

Unlike AM or FM, the shortwave range (also known as the "high frequency band") is a radio "soup" filled with every imaginable kind of signal. There are foreign broadcasters speaking in a hundred different tongues. There are unlicensed pirate stations broadcasting on catch-as-catch-can schedules. Several shortwave segments are the preserve of amateur (ham) radio operators, and you'll find them chatting with each other, handling messages from third parties or phone patches, or even helping with communications during a natural disaster.

You can tune in on the pilots of jetliners as they fly across the ocean. You can listen to maritime communications—everything from an ocean liner on a Caribbean cruise to tugboats on the Mississippi. You can set your watch with the world's most accurate time keeper: the National Institute of Standards' station WWV which offers non-stop time signals. The governments and militaries of the world also use shortwave for a wide variety of communications. Many SWLs have picked up signals from Air Force One and tuned in on tank battles during the Gulf War!

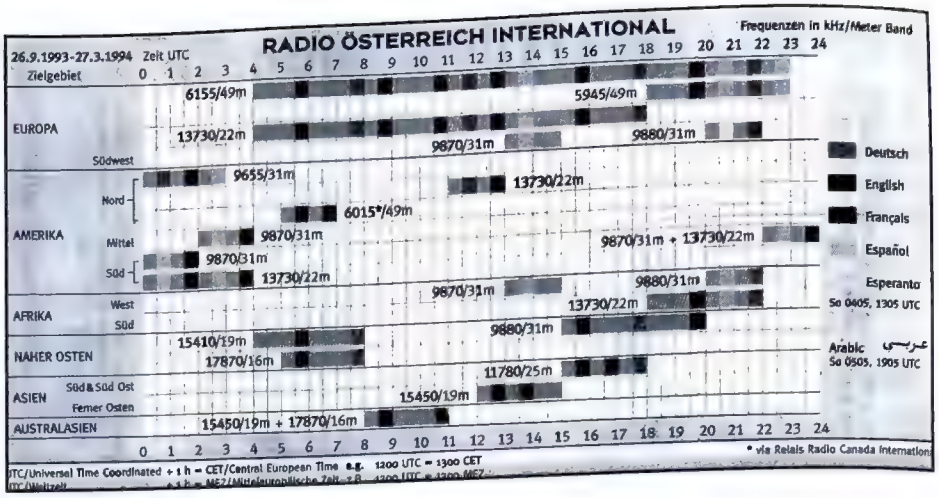
Shortwave has its dark side, too. You may run across a voice reading strings of numbers, usually in Spanish. These are believed to be some sort of "spy" transmissions. They have been on the air for some 30 years and no one has yet solved the mystery of these strange signals. There are also mysterious stations backed by unknown groups, broadcasting against a particular government in the hope of one day stirring up a revolution. Many such broadcasts are on the air now, calling for the end of the Castro regime.

If all the signals in the shortwave range could be "seen" at the same time—if you photographed that picture twice, as fast as you could click the button, you'd find the second picture different from the first. There are so many signals coming and going on shortwave that no two seconds are exactly alike! Little wonder, then, that there are people who never listen to anything else!

A La Mode

There is still another way in which shortwave differs from AM and FM. All the stations on AM broadcast using amplitude modulation (AM), and all those on FM use frequency modulation (FM). It's a different deal on shortwave, though. The broadcasters use AM, so any shortwave radio will provide understandable signals. But, beyond the broadcasters, all bets are off. There are many transmissions which use single sideband (SSB), a mode which, essentially, amounts to sending and receiving only half the AM signal. If a shortwave radio isn't equipped for SSB reception, then what you hear won't be understandable. Either the Radio Shack DX-390 or 392 receivers have SSB capability and a multitude of other convenient features. If you're interested in only hearing international broadcasters, the DX-351 for $49.99 or DX-375 for $99.99 are adequate.

Shortwave signals may also be sent in Morse code (CW)



This time and frequency schedule from Radio Austria International is typical of a medium-sized shortwave broadcaster.

or various forms of radioteletype (RTTY), which require specialized add-on equipment to decode.

Voices of the World

The foreign broadcasts are shortwave's biggest attraction for most people. No other medium offers such a large and varied output of news in any given day—including CNN and all other news broadcasters! Spend a few hours listening to the BBC (British Broadcasting Corporation) and you'll begin to realize how much is going on in the world that you don't hear about. Dan Rather isn't kidding when he says "that's part of our world tonight." Part is the operative word! Radio Bulgaria, for example, doesn't concern itself with the latest Washington scandal, it focuses coverage on events in and around Bulgaria.

There are more than 100 countries broadcasting on shortwave and most air at least some of their programs in English. Some stations are gigantic operations, broadcasting around the clock from monster transmitters capable of half a million watts of power! Some stations operate in English most of the time and even beam several hours of programming to North America each day. Others may broadcast to North America for only a half hour a day, a few even less than that. Let's point out that broadcasts not directed to North America can still be picked up, often quite well, but those aimed specifically at this continent are generally heard best.

These large stations usually have many transmitters, use many different frequencies at the same time, and may even broadcast to different parts of the world in different languages on different frequencies simultaneously!

Some stations, especially the bigger ones, usually have long and often complicated operating schedules. And, because of seasonal changes in shortwave propagation or interference problems, they are likely to make changes in their frequencies from time to time. Unlike your local FM rocker, most shortwave stations aren't going to be at the same spot on the dial 24-hours every day! Fortunately, most of the larger stations will send you a free copy of their program/frequency schedule if you write and request one.

Some stations don't try to speak to the whole world. Focusing on a particular region, they may not use any language other than their own. Radio Australia and Radio New Zealand both focus their attention on Asia and the Pacific, though both stations can still be heard quite well here. (And because they focus on Asia and the Pacific they are excellent sources of news from those areas!)

There are also many shortwave broadcasters who use the medium as a way of covering areas within their own country that they couldn't reach otherwise. Some African countries use shortwave for this kind of regional coverage. There are hundreds of commercial and educational/religious stations in Latin America which use shortwave to reach an audience beyond the range of their AM or FM stations.

The Shortwave Landscape

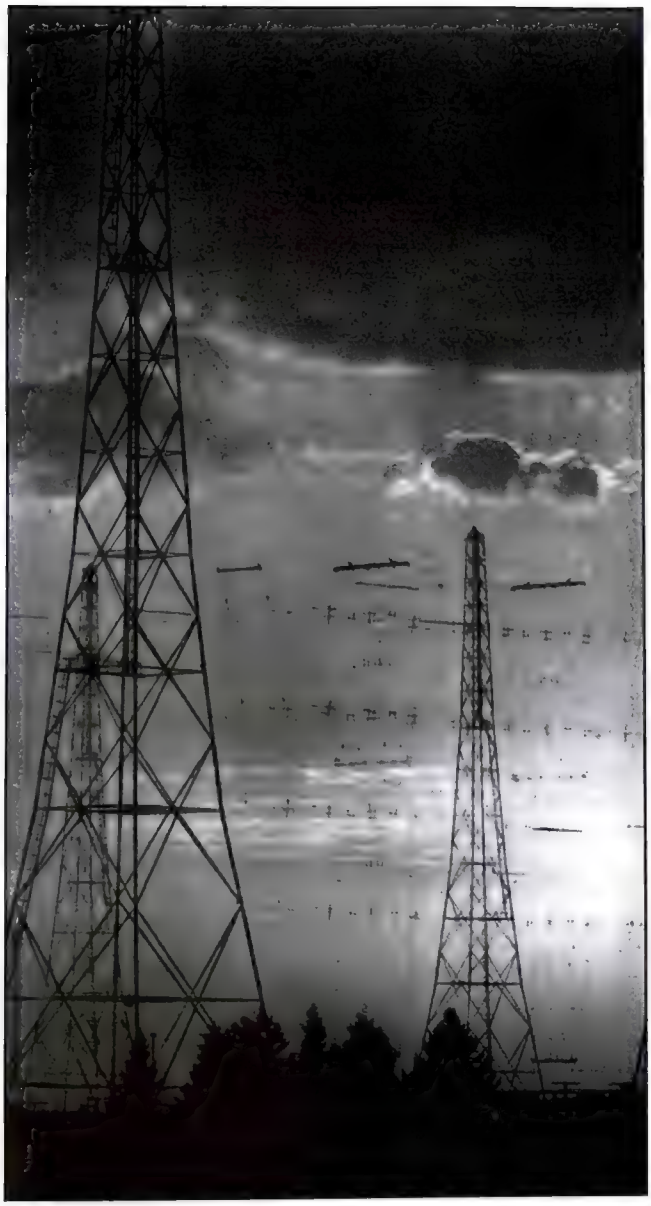
The shortwave frequencies are more or less divided into various frequency ranges, designated for broadcasting, amateur radio, or two-way aero or marine communications. We say "more or less" because there is a lot of infringement by one medium into another area and also a lot of shared territory. Some broadcasters ignore these gentlemen's agreements and operate on out-of-band frequencies in order to get away from interference. Let's get acquainted with those frequency bands designated for broadcasting on shortwave.

2.3–2.495, the 120-meter band: There are only a few low power broadcasters using this area, including a handful in Brazil, three Australian "outback" stations and several in Indonesia. Reception down here is very chancy and extremely dependent on the right propagation conditions; don't expect to hear very much. Reception is possible only during the hours of darkness.

3.2–3.4, the 90-meter band: This is another area populated by local broadcasters. There are a few more of them here than on 120 meters, and reception isn't quite as difficult. Again, though, you won't hear anything until around sunset at your location. The majority of stations in this area are in Latin America, Asia and Africa.

3.9–4.0, the 75-meter band: There's not much to be found in this range other than a couple of European stations and one or two Africans. This band is shared with ham radio operators, so you're likely to encounter a lot of interference.

4.75–5.06, the 60-meter band: There's a wide range of local and regional broadcasters in this area from Central and South America, Asia and Africa. The band will begin to "open" an hour or two before your local sunset and may stay open for an hour or more after sunrise before going "dead" for the



Gigantic transmitting towers such as these can send shortwave signals all the way around the world.

daytime period. It's possible to hear an African station sign off at 2300 UTC and then catch it signing on for the day at 0500 or 0600. Latin American stations will be heard in the evenings and again in the early morning. Asian stations will show up later in the morning. You'll find lots of local music from Africa and Latin America here.

5.9–6.2, the 49-meter band: This area is about half local/regional stations and half international broadcasters. The band can get quite congested, especially in the prime time evening broadcast period. You'll find activity here from the late afternoon until well after sunrise.

7.1–7.35, the 41-meter band: Stations in every part of the world (except North America) use this band, which is shared with amateur radio operators (up to 7.3 MHz). Like all the other "bands," several stations operate outside these limits (look for RTT Tunisia on 7475). Unlicensed pirate broadcasters can sometimes be heard on such frequencies as 7415 and 7465, mostly on weekends or holidays. This band opens up earlier in the afternoon and stays usable later in the morning.

9.4–9.9, the 31-meter band: This area contains mostly international broadcasters, including everything from Radio Nacional de Venezuela to Radio Australia to Vatican Radio and dozens more. There are some local/regional stations, too, however. Check 9735 in the evenings for some nice music from Radio Nacional de Paraguay. You'll find this band active for much of the day and night.

11.6–12.1, the 25-meter band: Very much like 31 meters in content, but it tends to lose its ability to carry signals sometime in the later evening hours. These higher frequency bands are much more dependent on solar activity. A couple of years ago, when solar activity was at the peak of its 11-year cycle, this and the other higher bands were usable virtually around the clock. A couple of years from now, when solar activity will be even less than it is now, the band will be even more limited to daytime use.

13.57–13.87, the 22-meter band: This is a relatively new band which was designated for shortwave broadcasting by international agreement a few years ago; it's now in the process of being expanded. With the sunspot count, and hence the degree of solar activity on the decline, it is limited mostly to daytime reception.

15.1–15.8, the 19-meter band: This is another source for signals from every part of the globe, including Vietnam on 15010, Iran on 15084, Morocco on 15335, and hundreds of others. Like 25 and 22, its usefulness is more and more restricted to the daylight hours.

17.48–17.9, the 16-meter band: The only parts of the world not well represented here are Asia and Latin America. You'll hear plenty from Europe and Africa. This is even more a daytime use band than 15 MHz.

18.9–19.02, the 15-meter band: This is a new area designated for use by international broadcasters. They're not really supposed to be using it yet, but a few have jumped the gun.

21.45–21.75, the 13-meter band: Decreased solar activity means this band is much more inefficient than it used to be, so fewer broadcasters are using it. It's strictly just a daytime affair these days.

25.6–26.1, the 11-meter band: Similar to 13 meters—only worse. Even in years when this band propagates well, it is pretty sparsely populated. Don't bother tuning this band in the evening.

The main control room at Deutsche Welle, The Voice of Germany, feeds a variety of programs for different parts of the world to different transmitters simultaneously.

The huge "transmitter hall" at the Vatican Radio, Vatican City.

In general, the lower the station's frequency, the more its reception requires nighttime conditions (including the hour or so before sunset and after sunrise). That means, for instance, that 60 meters will offer more hours of use in the winter months than it will in the summer.

In the middle frequency ranges, reception is less affected by day/night situations, although 31 meters will stay open longer in the summer than it will in the winter. Still higher bands, such as 17 MHz and up, will be more active during the day and consequently offer little or nothing at night. As spring moves into summer, these higher bands will stay open later into the evening.

Two Important References

Shortwave, even just its broadcasting portion, is a large, varied and changeable "place." This means it's a good idea to take a guidebook along when you go exploring, just as you would if you were touring a foreign country. There are two excellent reference guides to shortwave broadcasting stations. *The World Radio TV Handbook* and *Passport to World Band Radio* are available at most larger book stores or your local book store can order a copy for you. We recommend you obtain at least one of these books to help you find your way around. Other excellent sources of information are *Popular Communications* magazine and the *Popular Communications Guide*, both available from CQ Communications, Inc., 76 North Broadway, Hicksville, NY 11801. In the meantime, our "Best Bet" listing which accompanies this article will help get you started.

Finally...

Like most worthwhile things, shortwave requires some patience and some getting used to. But if you want global information and entertainment at your fingertips, if you are an armchair explorer at heart, if you've had your fill of trite and tired AM and FM and are looking for a real radio listening adventure, there's a good chance that shortwave listening is the answer. We'll bet you'll soon wish you'd started years ago! Good listening! ■

Best Bet Shortwave Broadcasts in English

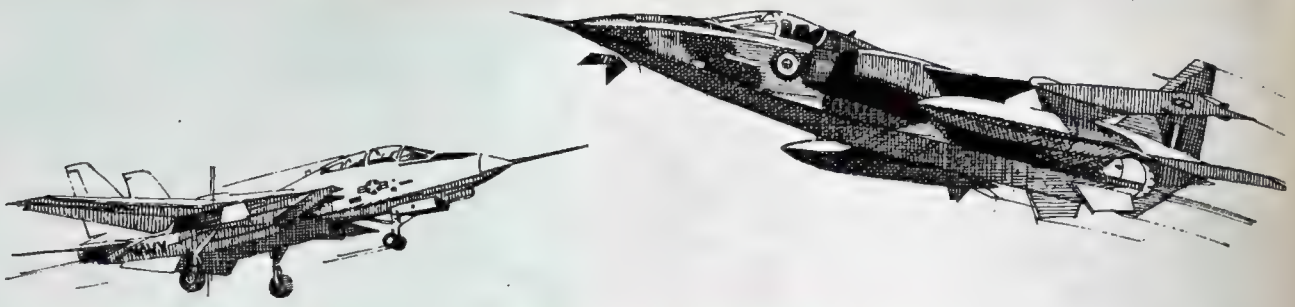
Along with the "Best Bet" broadcasts, we have provided a general grading system to give you some idea of what kind of reception you may expect from each station. This is based on the use of an average portable receiver under normal propagation conditions. A rating of one (*) is poor, two (**) is average, three (***) is good. Listeners in the western part of the U.S. will get generally better reception from Asia and the Pacific than will listeners in the east. Conversely, those in the east will enjoy better reception from stations in Europe and Africa.

Times indicated are Coordinated Universal Time (UTC) which is five hours ahead of Eastern Standard Time, so 0000 UTC equals 7 pm EST, 6 pm CST, 5 pm MST and 4 pm PST. All broadcasts listed here are in English and, on the average, represent the time and frequency combinations which should provide best reception.

Note: The quality of reception will vary with atmospheric conditions, your listening location and your receiving equipment. Stations may make changes in the times and frequencies of broadcasts with little or no advance warning. Not all of the frequencies listed for a particular broadcast will provide equally good reception; some frequencies may not even be in use. Stations may have other frequencies in use at the times listed here. Many stations are on the air at other times and on other frequencies. Some broadcasts are on weekdays only or are not on the air daily. Most station schedules are actually too long and complex to be included here.

Best Bet Broadcasts

Station	Time	Frequencies	Grade
R. Tirana, Albania	0130	9580	**
RAE, Argentina	0100	11710	**
R. Australia	morning	9580, 11800	***
R. Austria	0530	6015	***
R. Vlanderen, Belgium	0030	7370, 9930	*
Radiobras, Brazil	1200	15445	*
R. Bulgaria	0100	7455, 9700	**
R. Canada	2300	5960, 6120	***
China Radio	0000	9780, 11715	**
R. Havana, Cuba	0000-0700	6010, 9510	***
R. Prague, Czech Rep.	0100	5915, 7345	**
HCJB, Ecuador	0030	9745, 15155	***
R. Cairo, Egypt	0200	9475	*
BBC, England	24 hrs	5975, 7325, 9410 9590, 15220, 15260	***
R. Finland	1430	15400, 17800	**
R. France	1200, 1400, 1600	15365, 17620	**
Deutsche Welle, Germany	0100, 0300, 0500	5960, 6040, 9670	***
V. of Greece	0140, 0330	9380, 9420	*
R. Budapest, Hungary	0300	9835	*
All India Radio	2100	11620	*
Voice Islamic Rep. Iran	0030	9022, 11790	*
Kol Israel	1400	15640, 17575	**
RAI, Italy	0100	9725, 11800	**
R. Japan	0300, 1100	5960, 6120	***
R. Korea, S. Korea	1200	9640	*
R. Kuwait	1800	13620	**
R. Vilnius, Lithuania	0030	6020, 6165,11655	***
R. New Zealand	0600	9700	**
V. of Nigeria	0500	7255	*
R. Norway	Sun	1200, 15230, 17740	**
R. Portugal	0200	9570, 9705	**
R. Romania	0200	6155, 9510	*
R. Moscow	1200-0700	7165, 7180, 9685, 12050 15425, 17665	**
Slovak R., Slovakia	0100	5930	*
Channel Africa, S. Africa	0500	9695	*
Spanish National Radio	0000	9540	**
R. Sweden	0200	9695	**
Swiss Radio	0100	6135, 9885	**
V. of Free China, Taiwan	0200	5960, 9680	***
V. of Turkey	2300	9445	**
R. Ukraine	0100	7195	**
V. of United Arab Emirates	2200	9770, 11710 13605	**
Voice of America (VOA)	24 hrs.	5995, 9760 13710, 15205 15580	***
Vatican Radio	0250	7305, 9605	**
R. Nacional, Venezuela	0055	9540	**
R. Yugoslavia	0100, 0200	9580	**



Tuning Aircraft, Military Stations On Shortwave

Keeping track of high-flying air traffic and Uncle Sam is this easy.

By Donald E. Dickerson, N9CUE

One of the most interesting areas of utility DXing (listening for long distance stations) is commercial and military aircraft tuning. International and long distance domestic flights often use HF (high frequency) or shortwave radio to maintain contact with Air Traffic Control (ATC) facilities and company stations during long flights. And, luckily for radio enthusiasts, it happens to be easy to listen in.

The ARINC Network

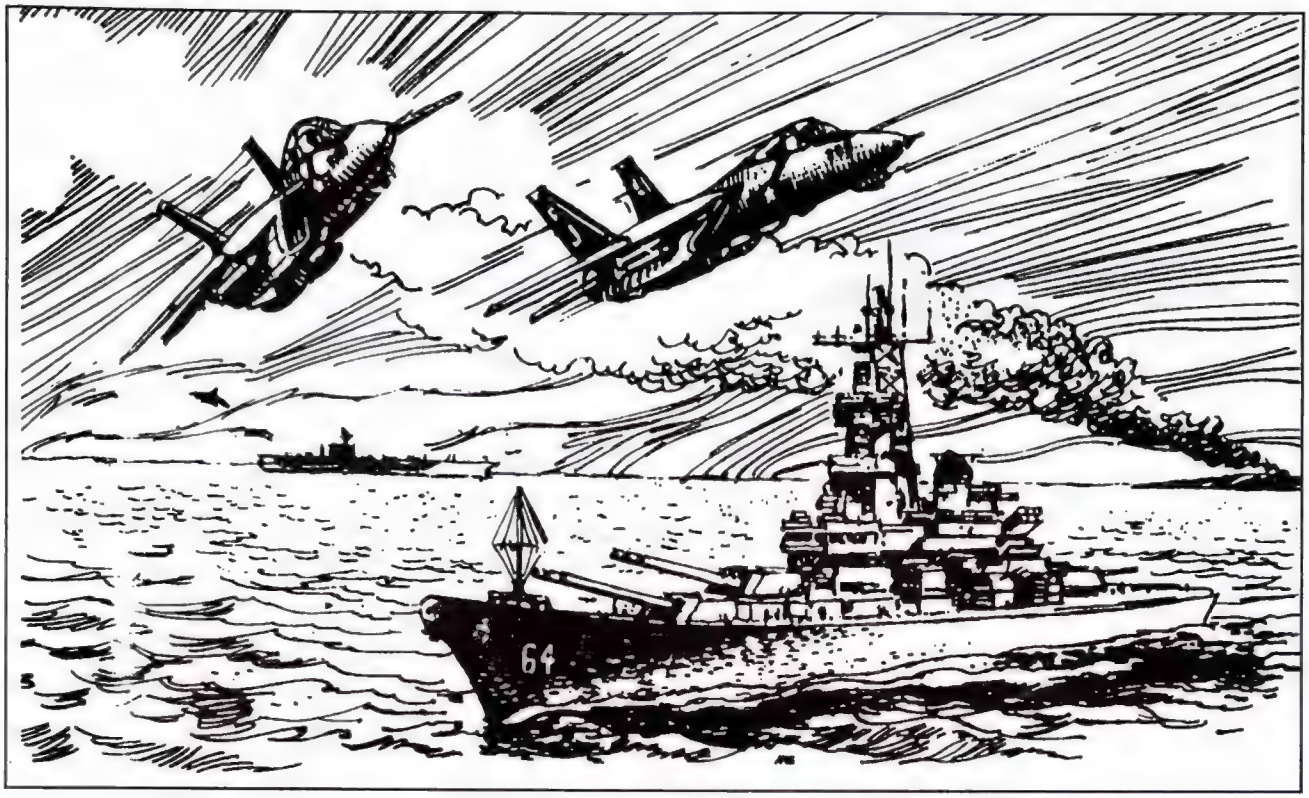
A company called Aeronautical Radio Incorporated (ARINC) is responsible for operating a network of HF stations that handle aircraft radio traffic. These are the same people who operate on the VHF bands. These communications facilities are often located at or near major airports, and you'll hear commercial and military aircraft calling into major centers with their latitude and longitude, altitude, air temperature, air speed and remaining fuel.

Each aircraft is assigned a "squawk" code on entering the net. Once this code is entered into the aircraft radio, it allows the crew to hear only messages or radio traffic directed specifically to them. In this way, they don't have to listen to all other radio traffic to and from other aircraft while they maintain a watch on that frequency. This is a multi-tone-paging system called "selcal," which is short for select call.

ARINC has divided the entire planet into roughly 35 radio control areas, each with its own set of assigned radio frequencies. There are other companies which provide similar services to aircraft. These and ARINC stations are part of what's known as the Long Distance Operational Control (LDOC) network of stations.

The airline companies themselves sometimes operate their

An air traffic controller in Stuttgart, Germany talks to incoming aircraft. (Photo by Harold Ort.)



Listening to military maneuvers is easy on shortwave.

own stations. Company HF and VHF stations are often the first to hear about problems aboard the aircraft—pilots want their companies to know the bad news first. If you hear, for example, a voice communications asking about a code 7500, it means there is serious trouble aboard. A 7500 means a hijack, 7600 means communications are down and a 7500 followed by a 7700 means armed intervention is requested upon arrival.

In addition to using commercial channels, the Air Force operates its own Global HF System (GHFS). Most Air Force bases worldwide operate on a set of frequencies for their region much like the ARINC system. You may hear any type of aircraft on these frequencies, including transports, tankers, fighters or electronic intercept aircraft known as EC-135s (a military version of a 707). Or, you might even hear from "Looking Glass"—one of the airborne command posts that are capable of launching our nuclear missiles.

Inside a government operations center.

Mystic Star

A separate network called as Mystic Star is operated out of Andrews Air Force Base. Known as SAM (Special Air Mission) flights, these VIP aircraft carry all kinds of military, diplomatic or secret service personnel as well as foreign political leaders. Their voice transmissions are in lower sideband (LSB).

Air Force One and Two can be heard on Mystic Star frequencies from time to time. The first two frequencies to check for this are 6.756 and 13.214 MHz. Because of the increasing use of satellites since the new 747 aircraft were delivered under the Bush administration, there may be somewhat

Frequency Information

Federal Emergency Management Agency (FEMA) (in MHz)

5.210	9.465	12.215	16.430
7.348	10.493	14.686	17.650
8.125	11.800	14.908	

Drug Enforcement Agency (DEA) (in MHz)

4.365	5.680	8.768	12.220	18.665
4.500	6.510	9.800	13.150	23.210
4.780	7.528	11.043	14.370	

Federal Communications Commission (FCC) (in MHz)

4.483	7.790	13.990

Federal Bureau of Investigation (FBI) (in MHz)

4.618	7.905	10.500	14.534	18.173
5.390	9.015	11.210	16.376	23.875
6.954	9.915	13.660	17.405	

VOLMET (Aeronautical Weather Stations) (in MHz)

Oakland Radio (CA)

2.863	6.679	8.828	13.282

Shannon Aeradio

5.592	8.870	13.270

Air Force One *(in MHz)*

6.680	6.812	9.023	13.205	20.016
6.683	7.614	9.958	13.215	20.053
6.716	8.893	11.035	15.048	23.623
6.735	8.965	11.118	17.975	23.576
6.760	9.010	11.180	18.205	

Mystic Star *(in MHz)*

4.487	7.735	8.162	10.427	14.902
5.340	7.699	8.170	11.153	15.555
6.993	7.922	9.270	12.240	18.490
7.305	8.029	9.958	13.760	19.047

Long Distance Operational Control (LDOC) (in MHz)
Aeronautical Ground Stations

New York

6.640	11.342	13.324

New York (ARINC)

3.494	11.324	17.925	21.964
6.640	13.330		

St. Johns, Newfoundland (Rainbow Radio)

3.458	8.819	13.420	17.910
5.604	13.285		

San Francisco (ARINC)

3.013	11.342	17.925	21.964
6.640	13.348		

Houston

5.529	10.075	17.940	21.964
6.637	13.330		

U.K. Stations

5.610	8.960	12.133	15.964	20.065
8.170	11.306	14.890	17.405	23.142

Lima Stations

5.535	8.885	11.306	17.937

Coast Guard Aircraft (in MHz)

2.261	5.696	8.648	11.201	12.887
3.120	6.381	8.984	11.513	15.081
5.692	6.788	11.195		

Coast Guard Ships (in MHz)

2.670	4.813	5.422	6.720
4.040	5.320	6.506	9.125

Coast Guard (Call) Split Frequency (in MHz)

USCG	8.765	**SHIP**	8.241
4.428	13.113	4.134	12.342
6.506	17.307	6.200	16.534

Coast Guard Emergency Frequencies (in MHz)

2.182	4.509	7.528	11.434
3.208	5.680	9.125	11.513
4.125	6.125		

Search and Rescue Helicopters (in MHz)

5.692	8.984	11.201	30.830
5.696			

Manned Spaceflight Search and Rescue (in MHz)

2.182	5.680	10.003	19.993
3.023	8.634	14.993	

Coast Stations

(WOO, New Jersey)

SHIP	12.336	**COAST**	13.184
4.090	16.553	**STATION**	13.107
8.238	22.027	4.385	17.325
8.216		8.762	22.632
12.413		8.740	

(KMI, California)

4.063	8.784	12.416	16.463	22.083
4.357	8.219	13.187	17.236	22.679
8.260	8.743			

Numbers Station Frequencies (in MHz)

6.768	7.527	10.366	13.685	15.637
6.802	8.212	10.612	14.419	16.840
6.825	9.123	11.430	14.968	17.428
7.404	9.918	12.166		

less traffic than before. But I have had some pretty interesting intercepts while monitoring these frequencies—these satellite systems are often down, however, and plain old unsecured voice transmissions are pressed into service.

Weather and NASA, Too

For the professionals who are responsible for the safety of ships at sea and aircraft aloft, accurate and up-to-date weather information is essential. For just such reasons, the HF bands are cluttered with weather broadcasts of all types. There are voice, CW, RTTY and FAX broadcasts. The Aviation Weather stations are known by their French acronym, VOLMET. VOLMET stations provide voice broadcasts of weather information to pilots on the HF bands.

Weather information for ships is broadcast by Public Coast stations and the AT&T High Seas stations. For an exhaustive list of weather broadcasts, pick up a copy of Anthony Curtis's *Weather Radio*, published by Tiare. It even includes sections on weather satellites and all the information you need to set up HF and VHF weather stations!

Mr. Curtis has also written a book about NASA that I think is the best available. It's called *Monitoring NASA Communications*, by the same publisher. NASA uses HF frequencies to support their shuttle and satellite launches. During a shuttle launch you can monitor the Coast Guard ship that is picking up the spent solid rocket fuel tanks from the launch. You might hear aircraft following the launch, landing, or simply doing security flights around the launch pad. Good bets are 5.180 MHz, which is used by ships, and 9.043 MHz, which is used by support aircraft.

During missions, NASA also simulcasts live shuttle audio for the crews on ships and military stations. The Goddard Spaceflight Center Amateur Radio Club also broadcasts live shuttle audio on amateur frequencies including 3.860, 7.185, 14.295, 21.395 and 28.650 MHz.

Other Federal Agencies On Shortwave

Shortwave is also used for routine data and voice backup for federal agencies' VHF/UHF networks, including the Federal Communications Commission, FBI, and The Federal Emergency Management Agency (FEMA). FEMA, one of the most active agencies using voice and data transmissions, is responsible for civil defense, preparing for natural and nuclear disasters, relief operations and recovery. Its HF communications network is central to FEMA's ability to respond during a national emergency, and it routinely conducts emergency drills over FEMA stations (its two primary channels are 5.211 and 10.493 MHz) in voice mode using upper sideband (USB). During natural disasters, FEMA will set up portable HF/VHF/UHF communications in the affected areas.

Numbers Stations

There is one final curiosity on the HF bands you should know about. These stations are called "numbers stations." As you tune across the HF dial, you might hear a female voice reading a long list of number groups and wonder to yourself what you're hearing. The transmissions may be in English, Spanish, French, German or almost any language. The most common seems to be in Spanish. The general theory among those in the radio hobby is that these stations are one-way secret (or, actually not so secret!) encoded transmissions to spies. The spy would need no incriminating equipment to receive a message from his handler other than a common, ordinary-looking portable radio. According to theory, the agent and his handlers use a pre-arranged code to translate the radio messages to meaningful information. These code lists are easy to conceal and destroy. They are used once and discarded, thus the name, "one-time pads." A spy message may contain 30 or 40 or more four or five letter groups that are repeated, often on more than one occasion. This is a proven way to safely secure a message. It is almost unbreakable unless you get a copy of the one-time pad in use that day. It's also a very practical and cost-effective communications system. It's no coincidence that many spy numbers stations use frequencies that are also used by military installations and embassies.

I hope your interest is piqued in listening to shortwave utility frequencies. As an added incentive, we've included an exhaustive list of commonly heard U.S. government, weather, aircraft and other frequencies with this article. Good listening and 73. ■

Sources and Recommended Reading

Confidential Frequency List, by Oliver Ferrell, Gilfer Shortwave, P.O. Box 239, 52 Park Avenue, Park Ridge, NJ 07656.

Weather Radio, Monitoring NASA Communications, by Anthony Curtis, Tiare Publications, P.O. Box 439, Lake Geneva, WI 53417.

Uno, Dos, Cuatro, by Havana Moon, Tiare Publications, P.O. Box 439, Lake Geneva, WI 53417.

Listening To Aircraft Radio, by Bob Bell, Airband Communications, P.O. Box 301, Chester Hill, 2162 New South Wales, Australia.

Shortwave Directory, by Bob Grove, Grove Publishing, P.O. Box 98, 300 S. Highway 64 West, Brasstown, NC 28902.

AM Broadcast Band Listening

Rediscover the simple pleasure of picking up AM stations from distant cities.

By Chuck Gysi, N2DUP

Many of us remember the excitement of lying awake at night with a transitor radio tucked under our pillow tuned to baseball games broadcast from faraway cities. That same excitement still exists today when you hear a distant broadcast over a simple AM radio.

If you're interested in such AM transmissions, it's really quite simple to dive in: almost any AM radio will do the trick. If you have a stereo receiver, the AM tuner on it will do just fine. Likewise, the AM radio in your kitchen or next to your bed will pull in some DX. Another good method of tuning faraway broadcasts is using your car stereo. Late-night driving is perfect for spinning that radio dial up and down while you log stations from one state after another.

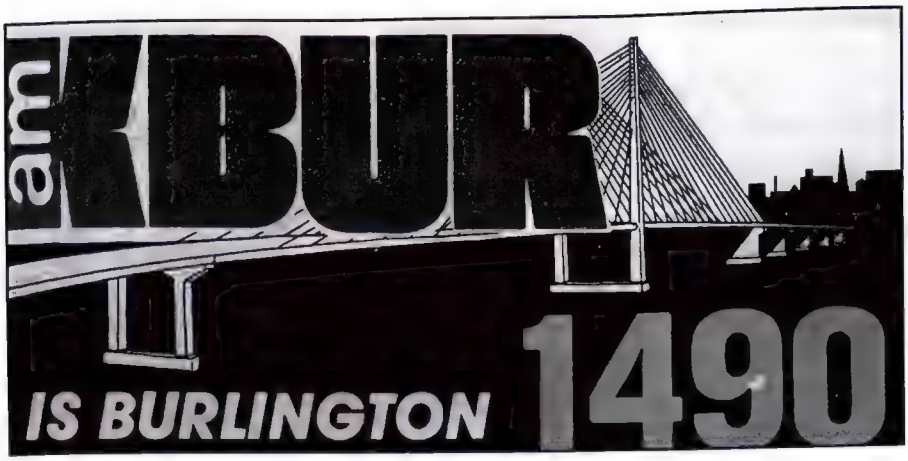
WHWH, a Princeton, New Jersey, AM radio station, uses a mobile studio for remote broadcasts away from its studios. (Photo by Chuck Gysi, N2DUP.)

History of AM Broadcasting

Amateurs and experimenters were the first broadcasters in the U.S. The first broadcasting license was issued on Sept. 15, 1921, to WBZ in Boston, Massachusetts. There were 25 broadcasting stations authorized by the end of 1921, and all were transmitting on 832.8 KHz. By 1922, there were more than 600 radio stations on the air and various frequencies came into use. Most listeners used homemade sets built around a galena or silicon crystal to receive signals from the "ether."

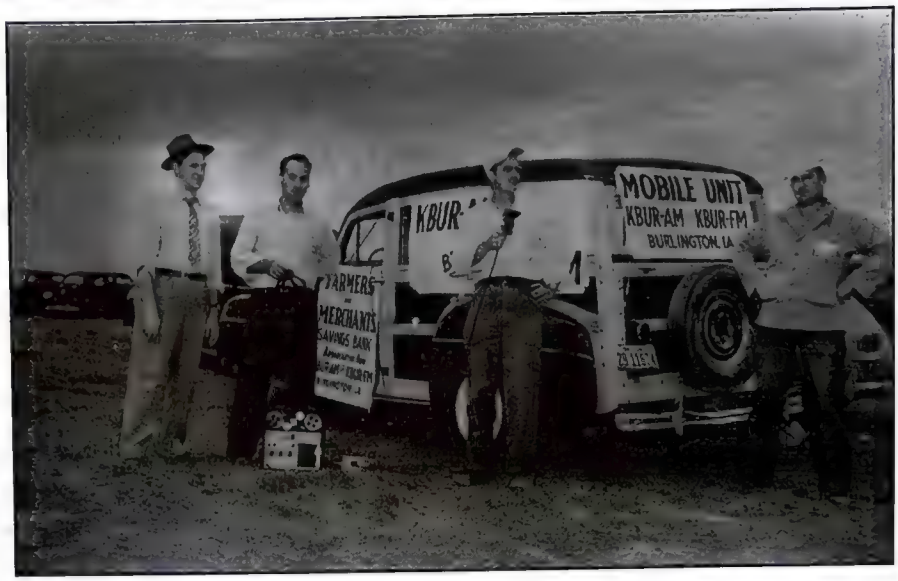
Network programming was carried by many of the early radio stations, much like it is today. American Telephone & Telegraph's WEAF in New York City made a profit of $150,000 in 1923 by licensing out-of-town stations to carry its programs.

The hobby of broadcast band DXing started about the same time as this early radio broadcasting. Because all the stations transmitted at 832.8 KHz, bedlam resulted on the single broadcasting frequency! Stations eventually migrated to other places on the radio dial and can now be found all over



This is a bumper sticker advertising KBUR, an AM radio station in Burlington, Iowa. The station uses a local channel, 1490 kHz, but still has been literally heard around the world.

Burlington, Iowa, radio station KBUR does a remote broadcast from the Des Moines County fair in 1948. It wasn't a live broadcast then, however, because a wire recorder (on ground) was used and then taken back to the station's studios to be aired. (Photo courtesy of station KBUR.)



the AM band, from 540 to 1600 KHz. In fact, over the next several years, many AM stations will ask the FCC to move their operations to an expanded portion of the AM band from 1600 to 1700 KHz. Stations that feel cramped by having too many other stations on their frequency may decide to move to this newly authorized band segment as it will be less populated, at least initially.

It Happens at Night

Radio waves travel farther at night than during the day, so most of your AM DXing will occur during darkness hours. Some of the best DX is at sunrise or sunset. A powerhouse station might begin to fade in as much as an hour or two before sunset and will get stronger as nighttime approaches. The solid nighttime signal may not become very strong until an hour after sundown. At sunrise, however, the reverse occurs—the first hint of morning light will result in a gradual reduction in the signal which will continue to fade after sunrise, perhaps lingering for only an hour or two more until it's totally gone. Keep in mind that with the changing seasons, sunrise and sunset occur at different times, affecting when you can pursue the DX stations.

In general, the best sunrise and sunset DXing will be in the early part of day from January through May and in the later part of the day from July through November. Sunrise DXing is also good in late December, while sunset DXing is good in mid-December.

Daytimers

Of the approximately 5,000 AM stations in the U.S., about half broadcast during the day only and sign off the air overnight. Many of these stations are in areas served by full-time stations or are in small or remote towns and cities. In the 1960s, the FCC gave daytime stations some added broadcast time, allowing them to sign on the air at 6 a.m. and operate with reduced power until sunrise. In most cases, the reduced power is 500 watts or less to avoid interference to other stations.

Logging Stations

Before you start trying to log stations up and down the AM radio dial at night, you should first determine the stations that are local to you. Since you can easily hear them during the day, you'll probably want to ignore these stations while searching for distant broadcasts at night. In the East and West, the list you compile will likely be local stations as well as powerhouse stations up to 100 or more miles away. In the Midwest and other wide-open areas, your list probably will include powerhouse stations in cities as much as several hundred miles away.

After you've completed your initial bandscan, you can search between those stations that you already have logged for new ones.

The Key Element

The key to identifying your catches is to know when stations give their call letters. The FCC requires broadcasters to give the call letters, as well as the city of license, every hour between 10 minutes before and 10 minutes after the top

of the hour. Some radio stations will have a slogan—such as "Wizzard 100"—and may use that for all identification purposes other than their legal ID. If you're trying to identify a station you're listening to, be sure to tune in the station at 10 minutes before the top of the hour.

Many stations will give their call letters right at the top of the hour, on the half hour, or even repeatedly over the course of an hour. But it's those stations with nicknames that give their call letters only once in the hour that are hard to identify. To find out what city a station is in, a trick is to listen closely to commercials for regional locations. For instance, knowing that one of the major streets in Chicago is East Wacker Drive might help identify a station location if you hear a commercial for a business at that unique street address. It's likely you'll hear the city of the advertiser, too, so it's important to pay close attention. If the station has a local newscast, place names will also help pinpoint the station.

Most broadcast band DXers keep a log of the stations they hear. Some like to keep track of how many stations, or how many states, they've tuned.

Verifying the Broadcasts

One popular aspect of broadcast band DXing is collecting verifications from individual stations to prove you actually heard their broadcast. While some stations have their own QSL card they'll mail you upon request, others will respond with at least a letter verifying your reception. When you write to the station (usually a letter addressed to the station's call letters in the city of license is sufficient for delivery), include information such as the day and time of your reception, a description of your listening equipment, a log of the program content you heard (include advertisers' names, information in newscasts, songs heard, etc.), and a general description of how well the signal was heard. The latter information will be of interest to the station's chief engineer, who may be the one who verifies your reception. If the station is satisfied with the program information you've provided, they will send you a QSL card or verification letter. It is considered polite to include return postage with your QSL request.

Clear Channels

Clear channels are certain frequencies on the AM broadcast band that have been set aside for wide area broadcasting at night, when usually only a few—or even just one—stations will be using one of these frequencies. This allows a station to serve a wider area at night, particularly in areas that aren't served by other stations. If you live on the East Coast, you'll be able to hear stations from New York, Pennsylvania, Virginia, Ohio, West Virginia, Canada, and other locations. If you live on the West Coast, you'll be able to hear stations in California, Oregon, Washington, New Mexico, Nevada, Canada, and Mexico.

These powerhouse stations transmit with the maximum power allowed in the U.S. and Canada (50,000 watts) all day and night. Outside the U.S. and Canada, some stations may transmit with even higher power: as much as 100,000 watts or more. While there may be other daytime-only stations that also use the clear channels, they are off the air at night, allowing listeners to hear the clear channel powerhouses from faraway places. Some of these stations even *cater* to their listeners from afar. For instance, WWVA in Wheeling, West Virginia, caters to truckers by playing country music and offering weather reports for interstate highways.

In addition to clear channels, there are also regional and local channels on the AM broadcast band. While the clear channels will be the easiest to hear, regional channels can also be heard at night. These stations serve a wide area and usually have a medium power output of 5,000 or 10,000 watts. Local stations typically serve much smaller areas, usually one community, and may transmit with between 250 and 1,000 watts. It is much more difficult to hear stations on local channels because there are so many of them. For instance, there could be as many as a dozen on the same frequency in a given state. Usually, only experienced broadcast band DXers try to tune in these stations. But don't let that discourage you—remember, they started out just like you. ■

Slogans

Many of the early radio stations had slogans or used their callsigns to coin a slogan. Here are a few stations still on the air today along with their old slogans.

WIP, Philadelphia, PA—Watch Its Progress
WBBM, Chicago, IL—World's Best Broadcast Medium
WSM, Nashville, TN—We Shield Millions
WCCO, Minneapolis, MN—Washburn-Crosby Co.

Key Words in this Article

Broadcast band—The band of frequencies from 540 to 1700 kilohertz where AM stations transmit their programming.
DX—long distance
DXing—the act of tuning in faraway stations.
DXer—one who searches for long-distance stations.
kiloHertz (kHz)—the measurement of frequency for AM broadcast stations; the place on the dial where the radio station can be found.
QSL—amateur radio signal for acknowledgment; also refers to a pre-printed card (or letter) sent out by a radio station to acknowledge a listener's reception.
Call letters—The official identification issued by a government agency to a radio station or transmitter. All AM radio stations in the U.S. have three or four letters in their call. Most stations east of the Mississippi River have a call sign that begins with a "W" while those west of the Mississippi River have a call sign that begins with a "K."

In Review: The Radio Shack DX-390 Receiver

By Jack Sheldon

Twenty years ago the hardest part about shopping for a portable shortwave radio was simply finding one—forget about the features and never mind the performance. But things have long since totally changed. Now you have a wide choice in everything from price range (under $40 to more than $2,000), to physical size (shirt-pocket to large purse or briefcase-sized), to band coverage, and to any number of high-tech features. It makes choosing such a radio a bit befuddling, especially if it's going to be your first purchase.

Well, maybe this will help. We've been looking at the Radio Shack DX-390 and we think it's something you too should look at, and listen to!

What You Get

The DX-390 is an easy-to-use portable that covers the longwave, medium wave (AM broadcast), and all shortwave frequencies, plus FM and FM stereo reception. It features four tuning methods. A rotary tuning knob on the side of the radio can be set to tune in 5- or 1-kilohertz segments (for shortwave, that is, other bands have different increments). You can also push up/down arrow keys to move in 5-kHz segments (again on shortwave, other bands have different increments). You can hold either of these keys down for two seconds and the receiver will scan to the next strong signal. Or you can tune the receiver by entering frequencies directly using the receiver's keypad. This has a comfortable feel to it and is simply a matter of pressing the FREQUENCY button, then the numbers of the frequency you want, followed by ENTER. The receiver can also remember 18 different shortwave frequencies which you've preset (nine on each of the other bands) and which you can quickly access as desired.

The frequency display is large and easily readable. The information window also indicates the meter band you're in (this will disappear with a beep when you tune out of a specified shortwave meter band). The display also shows one of two times (local or UTC, whichever way you've set it) and the clock will turn the radio on or sound a buzzer to wake you.

The strength of a received signal is indicated with a bar-type signal meter underneath the frequency display. The band you're on (LW, MW, SW, or FM) is indicated in the lower left-hand corner of the display. If you take the radio to Europe, you can change the increments on medium wave from 10 kHz, which is used in North America, to 9 kHz, which is the European standard.

Memory channel information is displayed in the upper right-hand corner. A dial light provides visibility at night. Unlike some sets, its control doesn't have to be held down. Once the button is pushed, the light stays on for 15 seconds—usually long enough to see where you're tuned or to tune where you want to be.

The Radio Shack DX-390 is an easy to use portable that covers longwave, medium wave and all shortwave frequencies, as well as offering FM and FM stereo reception.

There are two selectivity settings, AM wide or narrow, with the latter for cutting down on adjacent station interference. The RF Gain control lets you cool down some of the super strong signals or bring up those which are a bit weak. The BFO (Beat Frequency Oscillator, used for single sideband and Morse code reception such as is found on the ham radio bands) can be activated with an up/down switch and then adjusted with a variable control. We found the reception quality of hams using SSB to be excellent. Indeed, the radio provides a good sound on all bands and modes. The instruction book doesn't specify the size of the speaker, but it looks to be about five inches. There's a tone control, too.

Other Features

There is a multitude of other features, including a stereo headphone jack and battery operation (four "D" cells). AC or DC power adapters, headphones and the like all have to be purchased separately.

One switch will "lock" the receiver so you can't accidentally detune the station you've tuned. There's a combination world time chart and support stand on the back of the radio, which angles the receiver nicely when desired.

The instruction book is clearly written and easy to understand, something you don't always find. Don't rely on the station listings in the back of the booklet, however, as most are out of date.

While the DX-390 isn't designed as a "high-falutin" master DXing machine, it does *very, very* well in its intended role. It will provide reception of hundreds of international and local/regional shortwave broadcasters, not to mention the action on the amateur radio bands. The DX-390 is also lightweight, attractively designed, and easy to use. And it's well worth the $219.99 you'll spend on it. Give it a try! ■

Getting Your Ham Ticket Is Easier Than Ever

Ham radio is a hobby of a lifetime. Here's how you can join the thousands of new hams on the air.

By Gordon West, WB6NOA

If you're active in shortwave listening or scanner radio monitoring, chances are you've tuned into some ham radio operators "doing their thing" on worldwide frequencies (shortwave) or on the repeater bands (VHF/UHF FM). And if you're intrigued with not only talking on ham radio, but also with the many other capabilities of ham radio, like sending packets of digitized information over computers and the airwaves, and even real live television on ham radio, you, too, may be a ham candidate.

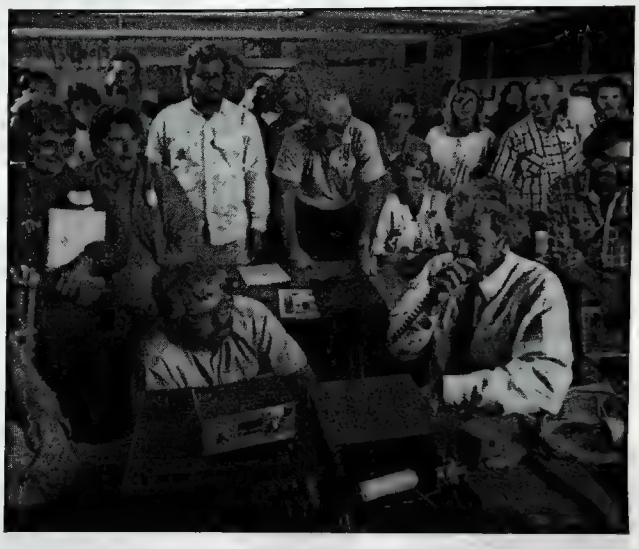
You no longer have to learn the Morse code to end up with voice privileges. The Technician no-code license, authorized by the Federal Communications Commission on February 14, 1991, puts you into the mainstream of every ham radio band there is from 50 MHz and higher. The following all-important bands are open to every "no-code technician":

6 meters	50-54 MHz
2 meters	144-148 MHz
1-1/4 meters	222-225 MHz
70 cm	420-459 MHz
33 cm	902-928 MHz
23 cm	1240-1300 MHz

plus 10 additional microwave bands

Wow, all these "mainstream" amateur radio bands, plus full power output at 1500 watts? All privileges, all emissions, and all bands as if you had an Extra class ham license? That's right—as a no-code Technician amateur radio operator, you have all the privileges of the very highest grade operator above 50 MHz.

And one of those bands above 50 MHz, the 6-meter band from 50-54 MHz, can also give you some exciting short skip and long skip propagation using SSB voice. Although we're entering a low point in solar cycle 22, the 6-meter band regularly "opens up" for ionospheric skip during the summer months from May to September. This is called Sporadic-E short skip, and a small rig can easily reach several thousand miles by bouncing off the ionosphere.



All photos by Gordon West

Ham classes are a fun way to enter the hobby of amateur radio.

Work Satellites and More!

The no-code Technician class license allows full satellite privileges, too. If you want to stay in touch with your friends in Europe, a no-code Technician class satellite station will do the trick nicely. And, of course, there are thousands of repeaters throughout the world on the 2-meter and 440-MHz band, frequencies to communicate with the space shuttle, autopatch frequencies for making telephone calls, as well as digital frequencies to work your computer over the air. All this and much, much more is available to you as a no-code Technician class operator.

The Multiple Choice Test

So what does it take to pass the test? About 30 days, and

A handheld transceiver, such as the Radio Shack HTX-202, can even tune into Space Shuttle audio on selected repeaters.

Suzy, N6GLF, starts out on ham radio on the popular 2-meter band.

a single book from Radio Shack, the *No-Code Plus Novice & Technician Class Theory Book.* And if you already know the code, brush up on your code copy skills on the four-tape set Radio Shack code courses.

What you will study are the questions that may be on your upcoming Technician no-code test. The same questions and answers, along with an explanation of the correct answer, are given, so there will be absolutely no surprises on the 55-question exam. Thirty questions are taken from the Novice Element 2 question pool, and 25 questions are taken from the Technician Element 3A question pool. You only need to score 74 percent on each pool to pass. You can take both exams at once, or take the Novice theory Element 2 first, bone up for a couple of weeks, and then go back and take Element 3A Technician theory second.

Once you've passed both elements, your examination team (made up of three local ham radio operators) will send in your test results to their local examiner coordinator. The coordinator, within approximately two days, will then send all of this paperwork to the Federal Communications Commission (FCC) in Gettysburg, Pennsylvania. After the FCC receives your passing examination information, your name and mailing address go into their computer, and out comes your written authorization and call letters that allow you to go on the airwaves above 50 MHz. It takes approximately 40 days for your license to finally arrive in your mailbox from the date you passed Elements 2 and 3A.

On The Horizon

The FCC is exploring the feasibility of temporary callsigns for an instant license after you've completed Elements 2 and 3A. They are also looking into " immediate licensing" just a few days after you pass the test through electronic filing of your examination results. This way, if you've passed, you can go on the airwaves almost immediately.

The Morse Code

If you learned the Morse code as a Scout or in the service, you should be able to pass the simple 5-wpm code test as part of your Novice Element 2 testing session, or combined Elements 2 and 3A testing session for Technician class. The code test is a simple five-minute message where you write down every letter, number, and punctuation mark you know, and then try to decipher what is being said on the code test. If you get five words in a row—26 letters—you pass! Numbers and punctuation marks count as two letters, too. And you don't need to copy the code letter perfectly—all you need to do is be able to reconstruct all that alphabet soup, and pull together five words in a row.

Passing the simple 5 words per minute (wpm) code test gives you additional voice privileges on the popular 10-meter band, 28.300 to 28.500 MHz. Voice privileges on 10 meters get real exciting when the band opens up for worldwide propagation off the ionosphere. Imagine working Europe, South America, and Asia on 10 meters with a little, tiny transceiver not much bigger than a CB set and an antenna that's really nothing more than a modified CB radio mobile or base antenna! In fact, if you are a CB radio operator now, you already have all of the makings for an ideal antenna installation for your new privileges on 10 meters.

THE PARTS PLACE SM

Radio-frequency LCD digital counter

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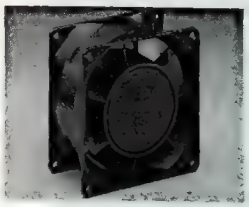
Big values in tools, test equipment, parts and accessories



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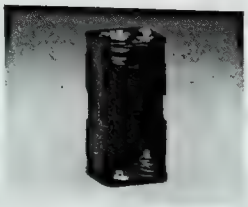

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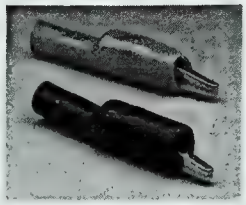

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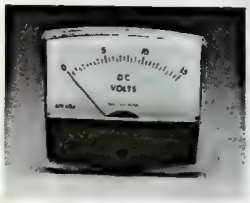

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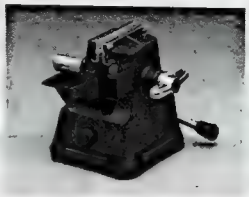

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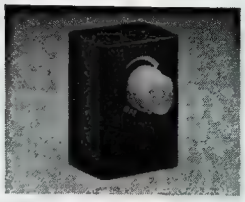

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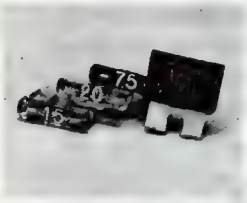

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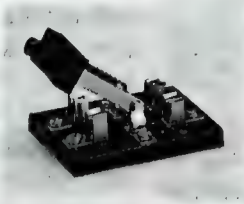

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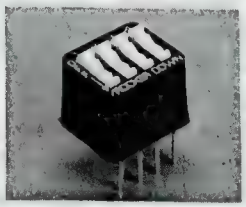

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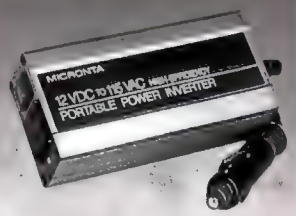

For camping, tailgate parties and emergencies. Plugs into car/boat lighter socket, converts 12VDC to 115VAC for powering a small appliance, light or tool. Rated 140W continuous. #22-132 ..... **99.99**

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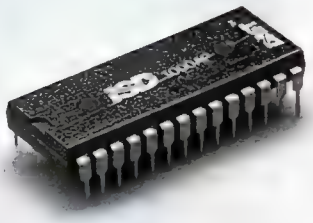

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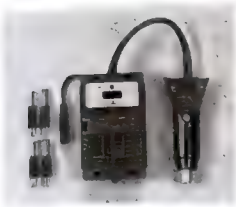

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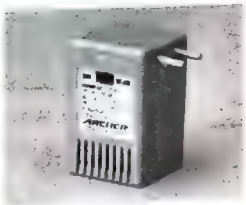

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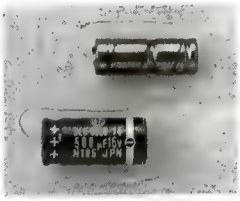
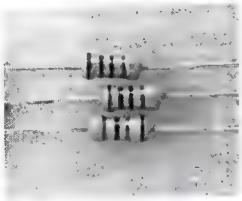


Electrolytic Capacitor Assortment. Includes mini and submini sizes in a variety of styles, rated up to 50WVDC. #272-802, **Set of 20/2.29**



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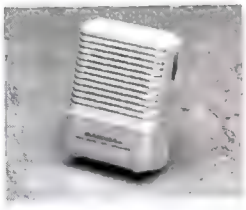

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Author Gordon West helps prospective hams study for their exams.

Passing the code as a Technician class operator gives you privileges of "Technician Plus" authorization. This means, in addition to everything above 50 MHz, you gain voice and digital privileges on 10 meters, and CW privileges (Morse code) on 15, 40 and 80 meters.

You don't need to take the code test at the same time you pass your Novice or Technician written exam. You can take the code test any time after you have received your Technician class callsign. Do it six months, lor five years later—as soon as you pass the code test as a Technician class operator, you instantly become Technician Plus!

So, step one to get into the amateur radio service as a licensed ham radio operator is to begin studying the Element 2 and 3A question pool. Get the Radio Shack no-code plus book. And, if you think the Morse code might be fun, pick up the four-tape code set. Then read the book and follow the instructions on how to learn the material and where to locate a local testing team to give your entry-level exams.

Spend about 30 days with the book and you should be ready to pass the tests with flying colors. Take an amateur radio class from a local ham club, and you'll gain additional momentum to zip through the exam session—plus you'll get involved with a club that will get you on the air in grand style. You'll find a list of local amateur radio clubs, plus a list of amateur radio instructors and examiners available at most Radio Shack stores. Just ask the manager for a list of contact phone numbers of helping hams who may live just a few minutes away from your house.

Then join the half-million licensed U.S. amateur radio operators who communicate over repeaters, to the Space Shuttle, off the moon, or off the ionosphere to millions of other ham radio operators throughout the world. Begin as a Technician or Technician-Plus operator, and then continue to upgrade to General Class, Advanced Class, and then ultimately Extra Class. Ham radio is a hobby of a lifetime, so get started now, and I'll look forward to working you on the airwaves. ■

Q Signals

Given below are a number of Q signals whose meanings most often need to be expressed with brevity and clarity in amateur work. (Q abbreviations take the form of questions only when each is sent followed by a question mark.)

QRG	Will you tell me my exact frequency (or that of ____)? Your exact frequency (or that of ____) is ____ kHz.
QRH	Does my frequency vary? Your frequency varies.
QRI	How is the tone of my transmission? The tone of your transmission is ____ (1. Good; 2. Variable; 3. Bad).
QRJ	Are you receiving me badly? I cannot receive you. Your signals are too weak.
QRK	What is the intelligibility of my signals (or those of ____)? the intelligibility of your signals (or those of ____) is ____ (1. Bad; 2. Poor; 3. Fair; 4. Good; 5. Excellent).
QRL	Are you busy? I am busy (or I am busy with ____). Please do not interfere.
QRM	Is my transmission being interfered with? Your transmission is being interfered with ____ (1. Nil; 2. Slightly; 3. Moderately; 4. Severely; 5. Extremely.)
QRN	Are you troubled by static? I am trouble by static ____ (1–5 as under QRM).
QRO	Shall I increase power? Increase power.
QRP	Shall I decrease power? Decrease power.
QRQ	Shall I send faster? Send faster (____ WPM).
QRS	Shall I send more slowly? Send more slowly (____ WPM).
QRT	Shall I stop sending? Stop sending.
QRU	Have you anything for me? I have nothing for you.
QRV	Are you ready? I am ready.
QRW	Shall I inform ____ that you are calling on ____ kHz? Please inform ____ that I am calling on ____ kHz.
QRX	When will you call me again? I will call you again at ____ hours (on ____ kHz).
QRY	What is my turn? Your turn is numbered ____.
QRZ	Who is calling me? You are being called by ____ (on ____ kHz).
QSA	What is the strength of my signals (or those of ____)? The strength of your signals (or those of ____) is ____ (1. Scarcely perceptible; 2. Weak; 3. Fairly good; 4. Good; 5. Very good).
QSB	Are my signals fading? Your signals are fading.
QSD	Is my keying defective? Your keying is defective.
QSG	Shall I send ____ messages at a time? Send ____ messages at a time.
QSK	Can you hear me between your signals and if so can I break in on your transmission? I can hear you between my signals; break in on my transmission.
QSL	Can you acknowledge receipt? I am acknowledging receipt.
QSM	Shall I repeat the last message which I sent you, or some previous message? Repeat the last message which you sent me (or message[s] number[s] ____).
QSN	Did you hear me (or ____) on ____ kHz? I did hear you (or ____) on ____ kHz.
QSO	Can you communicate with ____ direct or by relay? I can communicate with ____ direct (or by relay through ____).
QSP	Will you relay to ____? I will relay to ____.
QST	General call preceding a message addressed to all amateurs and ARRL members. This is in effect "CQ ARRL."
QSU	Shall I send or reply on this frequency (or on ____ kHz)? Send a series of Vs on this frequency (or ____ kHz).
QSW	Will you send on this frequency (or on ____ kHz)? I am going to send on this frequency (or on ____ kHz).
QSX	Will you listen to ____ on ____ kHz? I am listening to ____ on ____ kHz.
QSY	Shall I change to transmission on another frequency? Change to transmission on another frequency (or on ____ kHz).
QSZ	Shall I send each word or group more than once? Send each word or group twice (or ____ times).
QTA	Shall I cancel message number ____? Cancel message number ____.
QTB	Do you agree with my counting of words? I do not agree with your counting of words. I will repeat the first letter or digit of each word or group.
QTC	How many messages have you to send? I have ____ messages for you (or for ____).
QTH	What is your location? My location is ____.
QTR	What is the correct time? The time is ____.

Radio Codes

The radio user's verbal shorthand.

By Chuck Gysi, N2DUP

Different radio users have their own forms of verbal shorthand to use over the air. For instance, police may use "10-codes," hams use "Q-signals" (see elsewhere in this issue), and various public safety agencies may use phonetics to spell names and words over the air.

Two researchers who compiled a study for the Associated Public-Safety Communications Officers (APCO) in 1992 found that only 11 state police agencies in the U.S. didn't use any radio codes at all. Of the 38 state police agencies that do use radio codes (Hawaii does not have a state police agency), the number of codes used ranged from 29 in California to 104 in Georgia.

The study also found that 37 state police agencies use 10-codes in their radio communications, while two states, Massachusetts and Ohio, use codes in which a series of numbers have individual meanings, but no prefix such as "10." Connecticut and New Jersey, use "signals" which are much like codes in the previous two states, while Oregon uses a "12-code." Colorado, Idaho, Michigan, Montana, New York, Rhode Island and Washington don't use radio codes for state police agencies; they use what is called "plain English."

In many larger cities and metropolitan areas, fire and police departments are switching to "plain English" instead of radio codes for dispatching. For instance, instead of telling a police officer to "10-21," the dispatcher will simply tell the officer to "Please call the communications center." Likewise, instead of dispatching units to a "10-50," the dispatcher will advise units to respond to a motor vehicle accident.

The APCO state police codes study showed that while a lot of states use "10-codes," not all codes are universal in every state. For instance, "10-4," which usually means" affirmative," was used in 35 of the 38 states with codes. Only in Oklahoma does "10-4" have no meaning. Likewise, 36 states use "10-20" to mean "location." While APCO has issued its own standard 10-code for agencies to use, most states use only about a half of the actual code as issued. In fact, a third of all states use less than a half of the APCO 10-codes.

However, the primary focus of having radio codes is to allow the passage of routine messages over the air.

Official APCO 10-code list

10-1	Signal weak
10-2	Signal good
10-3	Stop transmitting
10-4	Affirmative (OK)
10-5	Relay (to)
10-6	Busy
10-7	Out of service
10-8	In service
10-9	Repeat (say again)
10-10	Negative
10-11	_____ on duty
10-12	Stand by (stop)
10-13	Existing conditions
10-14	Message or information
10-15	Message delivered
10-16	Reply to message
10-17	En route
10-18	Urgent
10-19	(In) contact
10-20	Location
10-21	Call _____ by telephone
10-22	Disregard
10-23	Arrived at scene
10-24	Assignment completed
10-25	Report to (meet)
10-26	Estimated arrival time
10-27	License or permit information
10-28	Ownership information
10-29	Records check
10-30	Danger or caution
10-31	Pick up
10-32	_____ units needed
10-33	Help me quick
10-34	Time
10-35 – 10-39	Reserved by APCO
10-40 upward	To be used on a local basis

Phonetics

These words are used to either spell out names, or report vehicle license numbers so that letters are not misunderstood. Two systems are in common usage (amateur radio operators typically use the second group):

A	Adam	Alpha	O	Ocean	Oscar
B	Boy	Bravo	P	Paul	Papa
C	Charles	Charlie	Q	Queen	Quebec
D	David	Delta	R	Robert	Romeo
E	Edward	Echo	S	Sam	Sierra
F	Frank	Foxtrot	T	Tom	Tango
G	George	Golf	U	Union	Uniform
H	Henry	Hotel	V	Victor	Victor
I	Ida	India	W	William	Whiskey
J	John	Juliet	X	X-ray	X-ray
K	King	Kilo	Y	Young	Yankee
L	Lincoln	Lima	Z	Zebra	Zulu
M	Mary	Mike			
N	Nora	November			

In Review: The Radio Shack HTX-404 UHF-FM Transceiver

by Ed Juge, W5TOO

No doubt the most popular single category of amateur radio equipment today is the handheld FM transceiver, or "HT." They can be used at home, on foot, in a car, boat, airplane, RV—or virtually anywhere. If there is a Swiss Army Knife of amateur radio, it has to be the HT.

Background

The introduction of the no-code Technician license a couple of years ago increased the popularity of HTs by several orders of magnitude. Technicians can use the Radio Shack HTX line of HTs on either 2 meters or 70 cm.

Using simplex frequencies, HTs provide excellent personal communications at hamfests, shopping malls, conventions and almost anywhere else short range (one to four miles) is involved. Plus, more than 10,000 repeaters are scattered across the country, permitting a simple HT to communicate with others anywhere within a radius of 50 miles or more. In some cases, linked repeaters extend that coverage statewide, or even across multiple states. HTs are also the primary communications devices used by hams engaged in public service and emergency communications.

Modern HTs are the closest thing we may ever see to Dick Tracy's wrist radios of 50 years ago. They come in sizes ranging from shirt-pocket to what might be described as a real handful. Some operate on a single band, many are dual-band, and you'll even find a three-bander or two. Some are capable of output exceeding 5 watts, while others are restricted to 1 watt of transmitter output.

A mind-blowing array of options makes choosing an HT a daunting task. These include touch-tone pads (for dialing automatic telephone patches and controlling remote stations), selective calling, and paging options. Certainly there are hams with a real need for some of these sophisticated options. All too often, though, a ham buys a feature-rich HT only to find that the complexity of programming them becomes tedious and that many of the features are never used.

Its Precursor, the HTX-202

A couple of years ago, Radio Shack introduced the HTX-202. This solid, mid-size 2-meter HT with a broad array of features, and a couple of surprises, took the market by storm.

The Radio Shack HTX-404 UHF-FM Transceiver provides an extremely pleasant operating experience.

When it was introduced, the 202 was at least $100 under its competition and became the "backup HT" of choice, as well as the first radio for many new licensees. The design criteria included a couple of unique standards.

First, the HT had to do the best possible job at its primary task: amateur band communications. Rejection of interference from local commercial and paging stations was given a high priority. "Tighten up that front end, and forget trying to make a scanner out of it" were the watchwords. The result is unquestionably the most intermod-immune 2-meter HT receiver available. It outperforms many full-size home/mobile units costing three times as much.

Second, the speaker and audio system had to provide plenty of distortion-free receiver audio. You can wear this HT on your belt at a noisy hamfest and never miss a call! Many of today's HTs have been miniaturized to the point where the speaker goes into near meltdown when the audio is turned up beyond half scale. This isn't a negative comment on other designs, it's just the laws of physics in action. Of course, the folks building the super-miniature HTs sure sell a lot of speaker/microphones; it's the only way those HTs are usable in anything but the quietest of rooms.

Third, Radio Shack's product manager, a serious packet operator, insisted on true FM modulation rather than the phase modulation used by 90 percent of today's HTs. The result is good, clean audio that works very well with voice FM or packet radio.

Finally, the design team wanted decent battery life. As miniaturization gains in popularity, batteries shrink and operating time between charges drops proportionally. The HTX HTs not only have decent size batteries, they are also compatible with batteries built for the older ICOM HTs. This means many of the aftermarket suppliers can supply high-capacity batteries for the HTXs.

The HTX-404

But this is supposed to be a review of the HTX-404, not the 202, right? Right. Well, for the reasons listed above, the 2-meter 202 was such a success that the 404 was conceived as a 440-MHz (70-cm) version. And it embodies basically the same characteristics and design goals.

The HTX-404 comes with a rechargeable battery and charger, as well as a battery case for alkaline cells. It includes the antenna, a wrist strap, and belt clip. You also won't need to buy an add-on keypad, encoders or decoders, or CTCSS (sub-audible tones for repeater access or for keeping your receiver quiet until a specific station calls you). Many of these items are costly options ($50 or more) for other HT brands.

Plenty of Features

There is no lack of features in this compact HT. The 404 has one calling frequency memory, three "priority" memories and 12 standard memories. Touch-tone paging is supported. A programmable power saver can extend operating time between battery charges by reducing standby power drain when not in the scanning mode.

If your local repeater has an autopatch, the HTX-404 will store nine dialing sequences of up to 15 digits each, making dialing your most frequently used numbers a breeze. This feature is also useful for activating repeaters, remote-controlled stations, or alerting other stations equipped for touch-tone paging.

You can scan frequencies in the 70-cm band in a variety of ways. Scan your memories, priority frequencies or a frequency range. The scanning can stop on a busy channel for 10 seconds before moving on, or you may choose to have it stop until the carrier drops, or to simply stop scanning permanently on the first busy channel it finds.

Since local frequency spacing can vary, the HTX-404 lets you decide the frequency steps for tuning or scanning. The choices are 5, 10, 15, 20, 25, 50 and 100 kHz.

The transmitter power output varies from 1.5 watts, with a 7.2-Vdc supply or battery, to 5 watts on 12 Vdc, plus a low-power position that produces 0.5 watts on any power source. Receiver sensitivity (12 SINAD) is rated at 0.2 µV, with intermod attenuation of 60 dB, spurious response attenuation of 60 dB and adjacent channel (25 kHz) rejection of 50 dB.

Beyond Features and Specifications

I have owned more than a dozen different brands and models of the current generation HTs, including single-band models on 2 meters, 220 MHz, 70 cm, as well as dual-band units. For my taste, it takes more than seductive features, cute designs, and tiny shapes to make a great HT that you'll be happy with over a long period of time. Without the basics, the honeymoon is over pretty quickly.

First, the sexiest features aren't worth much if the battery dies quickly. I am a nut on battery life. There are HTs that draw 50 mA squelched (standby) and there are others that draw 12 mA. Couple high drain with a small battery and you have frustratingly short battery life. The HTX-404 with its larger battery and battery saver circuit scores well in this area.

Second, I much prefer an HT with strong, undistorted audio. I want to clip an HT on my belt and hear it in a noisy crowd. The HTX-404 takes top honors here also, with up to 1 full watt of audio output and a speaker large enough to handle full volume without distortion! If you buy a speaker/mic for this HT, it'll be for convenience, not because you can't hear the receiver without one.

Intermod interference can be terrible in some areas, including my hometown. If the HT will be used as a mobile with a magnetic mount antenna, the ability to reject interference can make the difference in communicating and not communicating. I enjoy listening to frequencies outside the ham bands as much as most people, but a dedicated scanner has no match for that purpose. I have never used an HT that could compare to a good scanner on aircraft, police, fire and other non-ham frequencies. Every HT I've used that covers those frequencies does so relatively poorly, and at the expense of performance on the ham frequencies. Radio Shack's HTX-202 and HTX-404 are not immune to intermod, but their ability to reject it is in a class by itself.

Finally, while more features always equates with more complex programming, some HTs are intuitive while some make no sense at all. There are HTs whose programming is

so nonsensical that you'll be consulting the manual every time you enter a new memory channel, unless you do it every day. Radio Shack's programming is quite intuitive and easy to remember. You'll develop a much closer relationship with your HT if it is simple to program.

Using the HTX-404

With all the frequencies available and in use today, quick selection is a must. The HTX-404 uses either direct entry (from the keypad), the tuning knob, or scanning. You can scan for active or inactive frequencies, though the former is the more common method. If you want to find a clear channel in an area where frequencies are extremely crowded, the scan for clear frequency option would be helpful.

It is often helpful to lock the keypad so you won't accidentally change the desired frequency once it is set. The 404 lets you do that and will even let you lock out transmit capability. In case you buy your 404 before you have a license to transmit, you can make sure you don't accidentally push the transmit switch.

Although more memory channels would be desirable, the HTX-404's complement of 12 standard channels, one calling channel, and three priority-frequency memories is adequate for most users. Each memory can be programmed with a different frequency offset and subaudible tone (CTCSS) setup. This feature is not available on every HT, but is a must in some areas, depending on local repeater operative conventions.

A unique feature of the HTX Series HTs is the ability not only to turn the CTCSS encode and decode tones on and off independently, but also to actually set those tones independently. You will find a growing number of repeaters using tone access to hold down interference from nearby signals. My wife and I nearly always use CTCSS on our HTs to keep them completely quiet except when one of us calls the other.

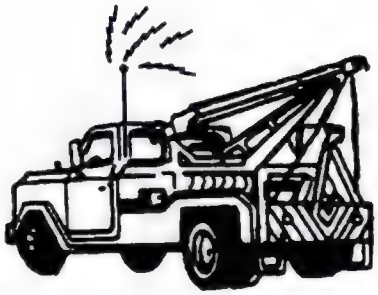
Another unique feature of the HTX-404 is a transmitter timeout function. Since many repeaters have a timer that will limit transmissions to one, two or three minutes, it's easy to talk beyond that limit without realizing the repeater has shut you off. You can activate the 404's transmit timeout, setting it for 30, 60, 90 or 120 seconds. When you transmit beyond the selected duration, it will stop transmitting and sound a warning beep. You need never "time out" another repeater!

The Bottom Line

For some reason the Radio Shack HTs look larger in their catalog photos than they really are—I'd characterize them as mid-size. They weigh in at about 19 ounces including the battery. That's a little big for a shirt pocket, but the great audio and longer battery life are well worth the small added bulk. If you need to hide your 70 cm HT in your watch pocket or coin purse, choose something else. But, if you want a rugged, dependable HT that's focused on amateur band performance and usability, then give the HTX-404 a close look.

There are few HTs available today that provide as pleasing an operating experience as the HTX-404 (which retails at $299.99).

Now, if Radio Shack only had a dual-band unit...



What Is GMRS?

The General Mobile Radio Service is the perfect communications choice for many people, perhaps even you....

By Johnny L. Stowers

The General Mobile Radio Service (GMRS) is a communications service licensed by the FCC for personal, non-business use. Although you do need a license for GMRS communication, there is no testing requirement as there is for amateur radio. Operating on GMRS is as simple as submitting an application along with the $35 fee, and waiting till your license arrives in the mailbox. The license is good for five years and covers all family members living in the same household.

One typical user of GMRS is the small "mom and pop" type business. These companies are not really big enough to license in the Part 90 commercial service, and they can use GMRS for small business traffic. Other users might be husbands and wives who want to stay in contact with each other and with the children during the daily routine or while on vacation.

With the right equipment, set up in the right manner, GMRS can be a great form of everyday communications for the average person. Depending on the capabilities of the radio and your specific needs, a handheld unit will cost from $140.00 to $500.00; a mobile will be in the same range. Again, this depends on what the radio can do and what you need it to do.

In most cases, a GMRS unit is cheaper than a cellular phone, is much easier to get involved with than amateur radio, and, in a lot of ways, is more versatile than both. The drawback is that you may need access to a repeater for any kind of distance. There are GMRS repeaters on the different frequencies all across the U.S. But, unlike amateur radio, there are no "open" repeaters on the GMRS: you must have authorization from the owner *before* you use a repeater. You'll have to check in your area and make arrangements with the owner for use of the repeater before you start using it. There are three major sources for this information.

1. *Your local REACT Team.* REACT teams across the U.S. use GMRS for communications to assist the public. If you don't know where to find your local team, you can contact REACT International for information; they will be more than glad to help you.

2. *Personal Radio Steering Group (PRSG).* A national directory is published annually by the Personal Radio Steering Group which lists a large number of the GMRS repeaters across the U.S. PRSG also has a number of publications aimed strictly at the GMRS user and a BBS which offers information that can be downloaded at no charge except for the phone call.

3. *Contact me personally.* I will try to help you as much as I can. ■

Sources of Information

Repeater Users Group, c/o Ed Greany, 1742 Spring Ln., Corona, CA 91720

Personal Radio Steering Group, P.O. BOX 2851, Ann Arbor, MI 48106, (313) 662-4533, BBS (313) 995-2100

REACT International, P.O. Box 998, Wichita, KS 67201, (316) 263-2100, FAX (316) 263-2118

Federal Communications Commission, Consumer Assistance Branch, 1270 Fairfield Rd., Gettysburg, PA 17325-7245, (717) 337-1212 8:30 a.m. to 4:30 p.m. M-F

Johnny L. Stowers, 4559 Gila Ave., San Diego, CA 92117, (619) 273-1268 (after 4 p.m.)

No-License 49-MHz Communications

Enjoy crystal-clear communications on any one of five channels.

By Gordon West, WB6NOA

The 49-MHz "communicator" band was specifically created by the Federal Communications Commission (FCC) to satisfy the need for a no-license set of frequencies. These frequencies, which provide crystal-clear voice and digital emissions, are located on five channels:

49.830 MHz
49.845 MHz
49.860 MHz
49.875 MHz
49.890 MHz

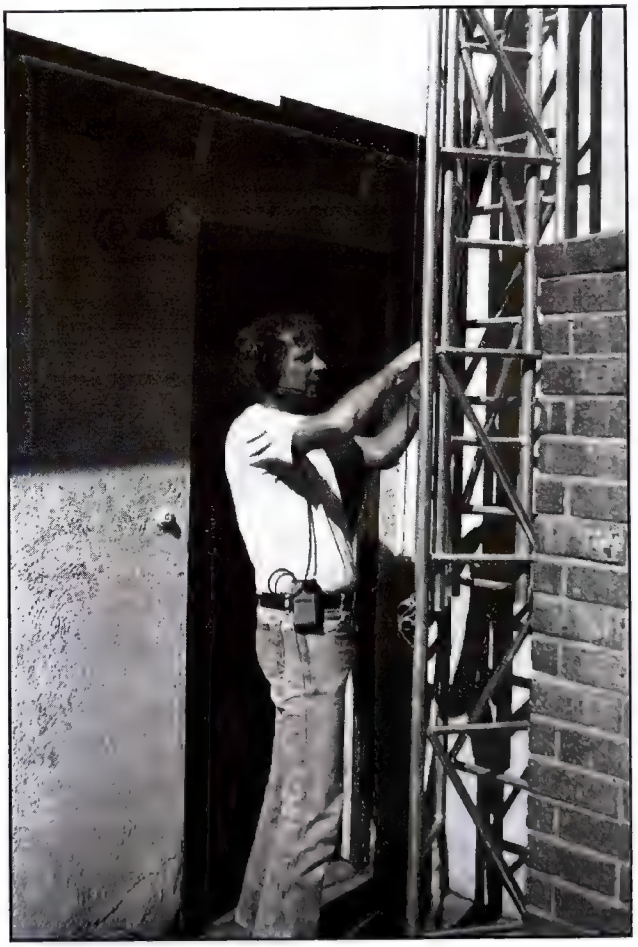
Professional-type 49-MHz communicators fall into a much different category than the toy walkie-talkies used by kids. The latter may only put out a fraction of the maximum power allowed by the FCC and may use old-fashioned amplitude modulation. The professional 49-MHz FM communicators, however, offer maximum legal power output. (According to the FCC Part 15.117 rules, up to 100 milliwatts of power input is allowed, for a possible communications range of up to 3 miles over water, and a half mile in cities.) The 49-MHz devices also offer crystal-clear FM communication emissions, squelch, channel selectors, and an extremely sensitive and selective receiver that captures only the on-channel signals you want to hear.

Best of all, the professional 49-MHz FM communicators

Any outdoor activity is more fun with 49-MHz communicators.

These convenient 49-MHz "communicators" give you hands-free operation with "VOX" circuitry.

County fair concessionaires often stay in touch up to 1,000 feet away using 49-MHz portable transceivers.



Portable 49-MHz "communicators" are especially useful if you're adjusting cables or an antenna and need to communicate with someone located inside the building.

require absolutely no FCC license for their operation. Unlike VHF business band radios that require you to work for a company and transmit only business calls, or General Mobile Radio Service (GMRS) transceivers licensed only to family members, 49-MHz communicators may legally go on the air as soon as you plug in the battery and start talking!

Up on 49 MHz, troublesome skip conditions found on 27 MHz CB frequencies are non-existent. And, since all 49-MHz equipment is limited to only a fraction of a watt output, your signal won't be drowned out by a more distant base station on the same frequency. The 49-MHz squelch control circuits also keep your radio absolutely silent until someone

calls you on any one of the five channels you've tuned.

There are many different styles of 49-MHz professional communicators. If you don't want to transmit and receive on a walkie-talkie style 49-MHz communicator transceiver, you can wear the radio on your belt and communicate over a lightweight headset. The more elaborate headset communicators allow you to speak and automatically trigger the transmitter. When you stop speaking, the transmitter will then cycle back to the receive mode, without your having to push any buttons at all (a feature called "VOX" for voice-operated relay). You also get a push-to-talk button in case you wish to override the VOX circuitry in a noisy environment. And, if you really want to go high-tech and money is no object, you could purchase a pair of 49-MHz communicators that incorporate full-duplex circuitry. This will allow you to talk and listen over a headset without the customary switching between VOX transmit and receive. Each 49-MHz communicator has its own permanently fixed antenna, which is usually a feather-weight telescopic whip or flexible stainless steel wire to help radiate and capture the radio signals. For special applications, the full-duplex 49-MHz communicators are one answer to the need for hands-free, short-range communications.

But don't be surprised if you hear other signals coming over your handheld or headset; there are many other low-power devices that use the same frequencies. Around the house, you might hear everything from your next door neighbor's baby monitor to the girl across the street talking over her cordless telephone. But once you get out on the lake, over to the shopping mall, or down to the shore, communications on any one of the channels should come in loud and clear. And if you should end up on a frequency in use, switch to an open channel and resume talking and listening.

In addition to being convenient and fun, these communicators may also get you out of some difficulties, or even worse. "I use a Radio Shack TRC-503 49-MHz handheld transceiver, and I can regularly talk ship-to-ship out on the lake up to a couple of miles away," comments Margaret Foster, an avid angler who always wants to be able to talk back to shore. "One time my engine conked out, and three or four different people with the same type of radio heard my call and came over to lend a hand," added Foster.

So look to the professional 49-MHz communicator equipment to satisfy your short-range, "under-a-mile" radio communication needs. These sets are much more powerful and hear a whole lot better than child walkie-talkies. The professional communicators at 49-MHz, operating FM, can give you some surprising range. ■

The Radio Spectrum

An introduction to how radio waves behave and a breakdown of the listening spectrum.

By Marvin Holladay

You can't see it, yet, like the air we breathe, it always surrounds you. Its invisible waves of energy carry the sounds you hear, cook your hamburgers in the microwave oven, bring you the local news on the radio, and carry the light that lets you read this page. What is it?—*the electromagnetic spectrum.*

Radio waves comprise a big chunk of the electromagnetic spectrum. And, just as light waves of different frequencies or wavelengths correspond to different colors, different portions of the radio spectrum have different characteristics. As a result, man (or more accurately, government agencies) has sliced this huge radio pie into many different pieces, based upon how a particular group of frequencies behaves. These big slices are segmented further, with different uses assigned to each, like broadcasting, amateur, government, industry, military, aircraft, satellites, and so on.

All these services use many different modulation modes (methods of transmitting information), including regular AM, FM, television, Morse code, single-sideband, many varieties of radioteletype, narrow and wideband FM, and other methods of even greater sophistication. Many of the beeps, burps, squeals and squawks you may hear aren't random noises, but methods of communicating information.

Only professional-quality radio receivers costing thousands of dollars can decipher *all* the modes. Indeed, most radios—even top quality units—don't cover the entire radio portion of the spectrum. A radio which will pick up the shortwave (high frequency) portion of the spectrum will give you access to foreign broadcasts from around the world, ham operators, ship-to-shore, aircraft and military communications, so-called "spy" transmissions, time checks vastly more accurate than the electronic sign in front of your bank, and illegal pirate broadcasters. A scanner radio will let you tune in on endless action closer to home, like police and fire calls, air and marine communications and those by government agencies, ranging from the post office to the FBI, to the park service. Shopping mall and stadium security, fast-food drive-in order windows, baby monitors, the sanitation crews, the National Weather Service, TV audio, telephones, amateur radio operators—they're all in there!

How Signals Behave

As we noted, each range of frequencies has different properties. For instance, during the daytime you normally do not hear stations from very far away on your AM radio. This is because the portion of the wave that shoots into the sky (the skywave) is absorbed by the lower part of the ionosphere during the day. You are hearing only the part of the signal (the ground wave) which travels along the surface of the earth and is eventually absorbed by the earth. The ionosphere is a region in the upper atmosphere upon which the sun's energy acts to create a layer of charged particles which can either reflect or absorb radio signals. At night this lower layer disappears, allowing the radio signal to hit a much higher layer, where it is bounced back to earth. At night, then, you are able to hear signals from further away.

On the higher, shortwave frequencies this day/night factor is not so pronounced, so it's possible for radio signals to reach a much greater distance day and night. Shortwave, however, has many variables: the portion of the shortwave band involved, day versus night, the time of year, the state of the ionosphere, and of the sunspot cycle.

Beyond shortwave, as frequencies get higher and higher, the day/night factor has no bearing at all on the signal. For instance, you hear the same stations on your FM radio during the day as you do at night.

Radio signals on these higher frequencies are much more a line-of-sight phenomenon. Unusual weather conditions and temperature inversions in the atmosphere can create temporary situations in which signals on these higher frequencies will travel a much greater distance than they normally would. You may suddenly find yourself listening to taxicabs from a city 800 miles away!

At frequency ranges of 300 and 400 hundred Megahertz (MHz) and higher, radio signals travel shorter and shorter distances. And they are more and more temperamental. Hills, mountains, buildings, even trees, can degrade the signal.

The radio spectrum is a thing to marvel at. The "little black boxes" we call radios bring to us slices of this giant radio pie and allow us to explore and eavesdrop on an endless, always changing world jammed with information, entertainment, and communications.

Help yourself to a piece of the pie!

Key Words In This Article

AM–Amplitude modulation. A radio frequency (RF) carrier signal combined with an information signal.

FM–Frequency modulation.

Frequency–Number of "waves" a transmitted signal produces in one second.

Hz–Hertz. A basic unit of frequency and an AC (alternating current) frequency of one cycle per second.

kHz–Kilohertz (1000 Hz).

Meter band–Expressed in meters, the wavelength or physical length of a transmitted signal's wave.

MHz–Megahertz (1,000,000 Hz or 1000 kHz).

Radioteletype–RTTY. Signals sent to and from teleprinter machines.

Skywave–Radio waves that use the ionosphere's refraction capabilities.

Sunspot cycle–A scientifically determined cycle of sunspot occurrences on the sun's surface that affect shortwave radio communications. A typical sunspot cycle is about 11 years, although scientists frequently argue the cycle is actually 22 years.

The Shortwave Bands Up Close

Frequency Range (MHz)	Meter Band
2.3– 2.495	120
3.2–3.4	90
3.9–4.0	75
4.75– 5.06	60
5.9–6.2	49
7.1–7.35	41
9.4–9.9	31
11.6–12.1	25
13.57–13.87	22
15.1–15.8	19
17.48–17.9	16
18.9–19.02	15
21.45–21.75	13
25.6–26.1	11

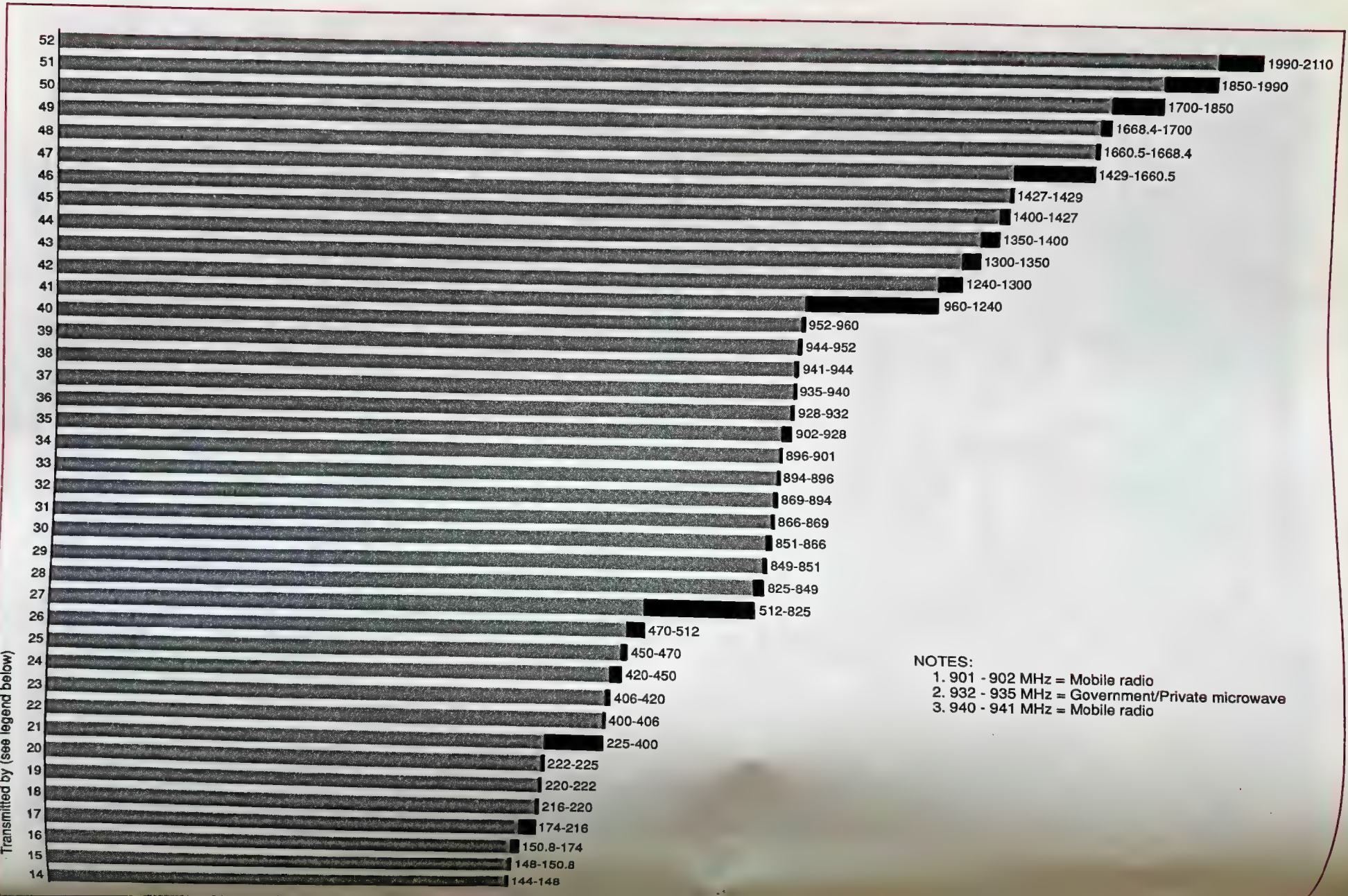
Amateur Radio Bands

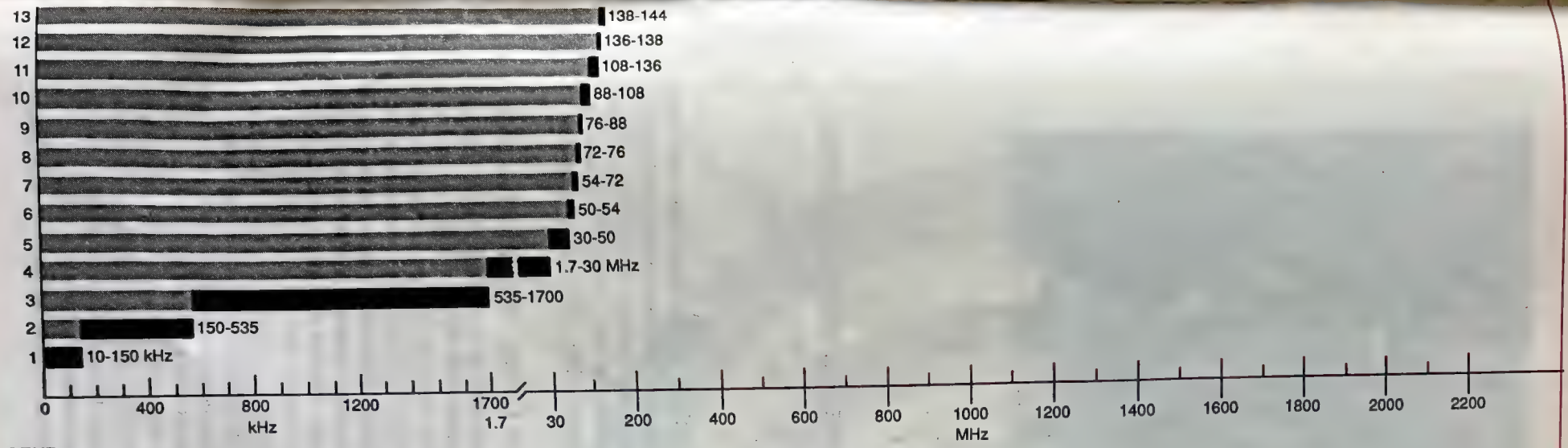
Frequency Range (MHz)	Meter Band
1.8–2.0	160
3.5–4.0	80
7.0–7.3	40
10.1–10.15	30
14.0–14.35	20
18.068–18.168	17
21.0–21.450	15
24.890–24.990	12
28.0–29.7	10

Note: Frequencies outside of the bands assigned to the broadcasting and amateur radio (and sometimes within them) are used by a wide variety of stations: fixed communications stations, maritime and aeronautical, U.S. and foreign military communications, U.S. and foreign government, standard time, so-called "spy" broadcasts, VOLMET aviation weather reports, shortwave broadcast feeder stations, unlicensed "pirate" broadcasters and more. Transmissions may be in voice (AM or single-sideband), Morse code, various forms of radioteletype, facsimile, or more esoteric forms of modulation.

A Look At The Radio Spectrum

10–150 kHz	Military/government, submarine communications
150–535	Longwave Band. Beacons, foreign broadcast, maritime
535–1700	AM Broadcast Band. (recently extended to 1700 kHz)
1700 kHz–30 MHz	Shortwave/High Frequency Band. Broadcasting, two-way government, military and commercial communications, amateur radio, others.(See "Shortwave Up Close")
30–50	Very High Frequency Band. Government, business, walkie-talkies, and cordless phones
50–54	Amateur radio 6 meter-band
54–72	TV Channels 2-4
72–76	Manufacturing, remote control, eavesdropping bugs, etc.
76–88	TV Channels 5-6
88–108	FM Broadcast Band
108–136	Aeronautical communications
136–138	Satellites
138–144	Military communications
144–148	Amateur radio 2- meter band
148–150.8	Military use
150.8–174	Business, highway, law enforcement, government weather, maritime
174–216	TV Channels 7-13
216–220	Maritime and aeronautical
220– 222	Land mobile communications
222–225	Amateur radio
225–400	Military aviation and space
400–406	Military and government
406–420	U.S. Government
420–450	Amateur radio
450–470	Ultra High Frequency Band. Business, industry, military, fire, government
470–512	TV Channels 14-20, shared with law enforcement
512–825	TV Channels 21-69
825–849	Cellular telephones
849–851	Aeronautical telephones
851–866	Business, public safety
866–869	Public safety, law enforcement
869–894	Cellular telephone systems
894– 896	Aeronautical telephones
896–901	Private land mobile units
902–928	Land mobile, amateur radio, personal communications units
928–932	Radio paging
935–940	Business radio
941–944	Government and non-government fixed services
944–952	Broadcaster's studio-to-transmitter links
952–960	Private fixed services, paging
960–1240	Aeronautical navigation
1240–1300	Amateur radio
1300–1350	Aeronautical navigation
1350–1400	Radio location
1400–1427	Radio astronomy
142–1429	Point-to-point, mobile, space
1429–1660.5	Various satellite transmission uses
1660.5–1668.4	Radio astronomy
16668.4–1700	Meteorological aids
1700–1850	Meteorological satellites, U.S. government
1850–1990	Fixed point-to-point, microwave
1990–2110	Broadcast studio-to-transmitter links


52 1990-2110
51 1850-1990
50 1700-1850
49 1668.4-1700
48 1660.5-1668.4
47 1429-1660.5
46 1427-1429
45 1400-1427
44 1350-1400
43 1300-1350
42 1240-1300
41 960-1240
40 952-960
39 944-952
38 941-944
37 935-940
36 928-932
35 902-928
34 896-901
33 894-896
32 869-894
31 866-869
30 851-866
29 849-851
28 825-849
27 512-825
26 470-512
25 450-470
24 420-450
23 406-420
22 400-406
21 225-400
20 222-225
19 220-222
18 216-220
17 174-216
16 150.8-174
15 148-150.8
14 144-148
Transmitted by (see legend below)
NOTES:
1. 901 - 902 MHz = Mobile radio
2. 932 - 935 MHz = Government/Private microwave
3. 940 - 941 MHz = Mobile radio



LEGEND:

1. Military/Government, submarine communications
2. Longwave Band. Beacons, foreign broadcast, maritime
3. AM Broadcast Band
4. Shortwave/High Frequency Band. Broadcasting, two-way government, military and commercial communications, amateur radio, others. (See "Shortwave Close-up" feature)
5. Very High Frequency Band. Government, business, walkie-talkie, and cordless phones
6. Amateur Radio 6-Meter Band
7. TV Channels 2-4
8. Manufacturing, remote control, eavesdropping bugs, etc.
9. TV Channels 5-6
10. FM Broadcast Band
11. Aeronautical communications
12. Satellites
13. Military communications
14. Amateur Radio 2-Meter Band
15. Military use
16. Business, highway, law enforcement, government weather, maritime
17. TV Channels 7-13
18. Maritime and aeronautical
19. Land mobile communications
20. Amateur radio
21. Military aviation and space
22. Military and government
23. U.S. Government
24. Amateur radio
25. Ultra High Frequency Band. Business, industry, military, fire, government
26. TV Channels 14-20, shared with law enforcement
27. TV Channels 21-69
28. Cellular telephones
29. Aeronautical telephones
30. Business, public safety
31. Public safety, law enforcement
32. Cellular telephone systems
33. Aeronautical telephones
34. Private land mobile units
35. Land mobile, amateur radio, personal communications units
36. Radio paging
37. Business radio
38. Government and non-government fixed services
39. Broadcaster's studio-to-transmitter links
40. Private fixed services, paging
41. Aeronautical navigation
42. Amateur radio
43. Aeronautical navigation
44. Radio location
45. Radio astronomy
46. Point-to-point, mobile, space
47. Various satellite transmission uses
48. Radio astronomy
49. Meteorological aids
50. Meteorological satellites, U.S. government
51. Fixed point-to-point, microwave
52. Broadcast studio-to-transmitter links

What Is World Time?

Whether you're in Alaska or New York, World Time is always the same.

By Myke Weiskopf

Picture this, if you will. You've invested your hard-earned money in a shortwave radio, and you've got all the angles covered. You've got your radio shack organized, you've got your antenna up, your radio is on, and you have absolutely no idea what time it *really* is. Unfortunately, this is a situation in which many new communications hobbyists find themselves.

Same, Just Different Names

"World Time" is known under several different names: Coordinated Universal Time (UTC), Greenwich Mean Time (GMT), and Zulu Time (Z). There is no real difference between any of these. UTC is used commonly between "utility" stations and on some shortwave stations. GMT is the most popular of these terms and is used by most international broadcasters. The term Z is used in military transmissions and is not often heard on non-utility transmissions. You will hear all three of these terms used on world-band radio.

World Time runs on a 24-hour system. In this system, midnight is 0000, while noon is 1200. Between noon and midnight, hours are numbered consecutively from 1300 (1:00 p.m.) to 2300 (11:00 p.m.). Of course, when it's 0000 UTC, there is a new UTC date in effect as well. If it is 0000 UTC and your local date is November 17 at 7:00 p.m., then it is November 18 UTC date. Use our handy time conversion chart (Fig. 1) to calculate World Time using your local standard time. Be sure to take Daylight Savings Time into consideration when calculating UTC. While UTC is not affected by Daylight Savings Time, your local time may be.

Setting Your Clock Via Shortwave

There are many stations worldwide which broadcast highly precise World Time, 24-hours a day, seven days a week. Usually they broadcast one "pip" per second, often with voice announcements before (or immediately following) the minute marker. Such stations are called time-signal stations and are usually broadcast on 2500, 5000, 10000, 15000, or 20000 kHz. The U.S. time-signal stations–WWV in Fort Collins, Colorado and sister station WWVH in Hawaii—broadcast on these frequencies. They can be found there at various times of the day, depending on propagation conditions. How do you tell them apart? WWV uses a male voice and broadcasts time announcements closest to the minute; WWVH uses a female voice and broadcasts its announcement several seconds before WWV. There are also station identifications (IDs) before the top of the hour (on WWVH) and just after the hour (WWV).

If you're listening in the northernmost part of the United

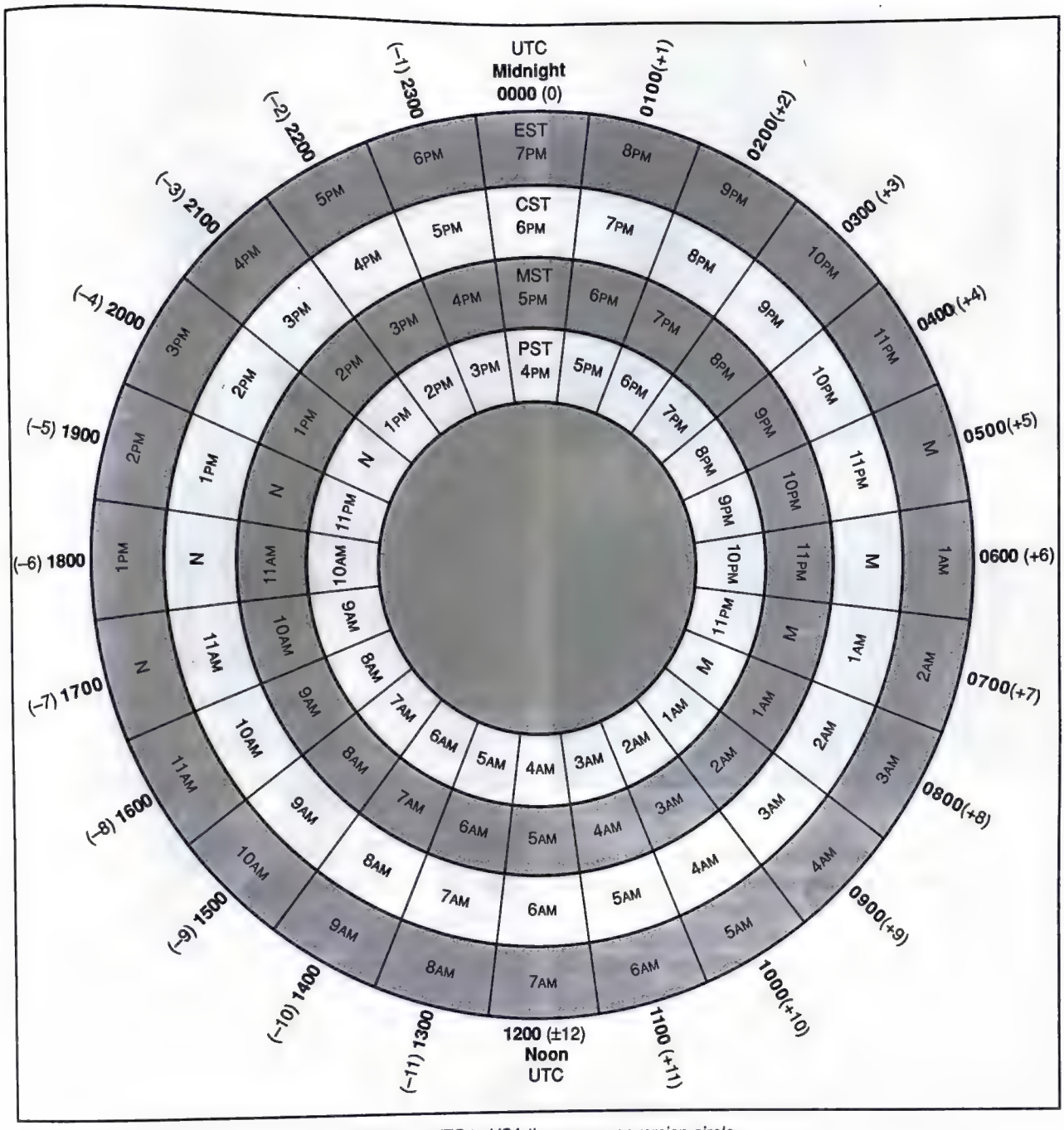


Figure 1 – UTC to USA time zone conversion circle.

States, you might also want to try receiving station CHU in Canada on 3330, 7335, and 14670 kHz. For more time signal station listings, please refer to Fig. 2.

Why Time-Signal Stations?

Time-signal stations receive their highly accurate time measurements from atomic clocks. Atomic clocks usually operate on a cesium-beam standard. The cesium atom is isolated in a small chamber with an ionized hoop. A reaction between this ionized hoop and the atom causes the atom to jump through the hoop and then jump back through again. One of these jumps is considered to be the length of one second. Thus, it makes sixty jumps per minute (and, once in a while, sixty-one).

Time-signal stations serve many other purposes besides time. They are responsible for maintaining a steady 60 Hz frequency (the frequency on which most U.S. power companies rely) and are used in maritime navigation. They are also useful for aligning the horizontal lines on your TV set; without time-signal stations, you would not be able to receive a clear, focused picture.

WWV (and certain other stations) also broadcast propagation forecasts and storm warnings for local areas. These are found at 16 minutes past the hour on WWV and at 46 minutes past the hour on WWVH. These propagation fore-

A QSL card from HD2IOA

Radio Shack catalog number 63–836clock.

casts give fairly accurate predictions which can be used to plan your shortwave listening schedule over the course of the next few days.

What Is a Leap-Second?

Every few years, you may be tuned to WWV/H and you may hear the following announcement.

> Your attention please. At the recommendation of the International Time Bureau, a leap-second will be added to the NBS Time Scale. This adjustment is required to maintain internationally Coordinated Universal Time as broadcast from these stations, in close agreement with UT1, or Astronomical Time. (Aloha.)

What is a leap-second? A leap-second is added (usually during leap-years, and for some years preceding and following) when the difference between UT1 (time calculated by the rotation of the earth) and UTC has become so great as to equal one whole second. Thus, a second is added into the time scale to compensate for this loss.

Leap-seconds can also make DXing time signals fun, simply due to the diversity of the announcements and the variety of languages they are broadcast in, which leads us to our next topic.

DXing Time Signals

Time signal stations are some of the most challenging sta-

2500 kHz:	HLA, Taejon, South Korea (24h) JJY, Tokyo, Japan (24h) VNG, Llandilo, Australia (24h) WWV, Ft Collins, CO (24h) WWVH, Ft Collins, CO (24h)
3330 kHz:	CHU, Ottawa, Canada (24h)
3810 kHz:	HD2IOA, Guayaquil, Ecuador (0500-1700)
4286 kHz:	VWC, Calcutta, India (1625-1630)
4996 kHz:	RWM, Moscow (24h)
5000 kHz:	ATA, New Delhi, India (1230-0030) BSF, Chung-Li, Taiwan (24h) BPM, Xian, China (1400-2400) HD2IOA, Guayaquil, Ecuador (0500-1700) HLA, Taejon, South Korea (24h) IAM, Rome, Italy (0730-0830, 1030-1130) JJY, Tokyo, Japan (24h) LOL, Buenos Aires, Argentina (11-12, 14-15, 17-18, 20- 21, 23-24) VNG, Llandilo, Australia (24h) WWV, Ft. Collins, CO (24h) WWVH, Kekaha, Kauai (24h) YVTO, Caracas, Venezuela (24h)
5004 kHz:	RID, Irkutsk (24h)
7335 kHz:	CHU, Ottawa, Canada (24h)
7600 kHz:	HD2IOA, Guayaquil, Ecuador (1800-0500)
8000 kHz:	JJY, Tokyo, Japan (24h)
8473 kHz:	4PB, Colombo, Sri Lanka (0553-0600, 1323-1330)
8638 kHz:	VNG, Llandilo, Australia (24h)
9996 kHz:	RWM, Moscow (24h)
10000 kHz:	ATA, New Delhi, India (1230-0030) BPM, Xian, China (1400-2400) JJY, Tokyo, Japan (24h) LOL, Buenos Aires, Argentina (11-12, 14-15, 17-18, 20- 21, 23-24) WWV, Ft. Collins, CO (24h) WWVH, Kekaha, Kauai (24h)
10004 kHz:	RID, Irkutsk (24h)
12745 kHz:	VWC, Calcutta, India (0825-0830)
12984 kHz:	VNG, Llandilo, Australia (24h)
14670 kHz:	CHU, Ottawa, Canada (24h)
15000 kHz:	ATA, New Delhi, India (1230-0030) BSF, Chung-Li, Taiwan (24h) BPM, Xian, China (1400-2400) JJY, Tokyo, Japan (24h) LOL, Buenos Aires, Argentina (11-12, 14-15, 17-18, 20- 21, 23-24) WWV, Ft. Collins, CO (24h) WWVH, Kekaha, Kauai (24h)
16000 kHz:	VNG, Llandilo, Australia (2200-1000)

Figure 2 – Time-Signal Stations. (Parenthesized times in UTC.)

tions to DX. Take a look at Fig. 2 again; you'll notice that there are many stations operating on 2500, 5000, 10000, and 15000 kHz. With WWV/H blasting their strong signals 24-hours a day, the difficulty in hearing these other stations quadruples. Station YVTO, Venezuela, 5000 kHz, is easy to hear in the summer hours. Station HD2IOA, Ecuador, 5000 kHz is slightly more difficult, but can still be heard. Even with the relative closeness of some of these stations, keep in mind that WWV/H has a stronger signal and will thus overpower any number of them which try to break through.

While we're on the topic of DX, let's dispel a myth: Stations on odd frequencies are easier to hear. False, false, false. While there is some advantage to not having to wade through incessant "deeee-deeee-deeee" to hear another station, there are often international broadcasters, ham radio operators, radioteletype signals, and other distractions to deal with. Station HD2IOA, Ecuador, is virtually impossible to hear on 7600 kHz because of the large concentration of ham radio folks operating there. Station VNG, Australia on 8638 kHz, sometimes gets weighed down with RTTY. CHU, Canada, on 7335 kHz, is overridden by Radio Beijing and Radio Moscow at odd hours of the day. Some stations are hard to hear simply because of their nature ("Other countries have time-signal stations, so why do they need to hear our signal?"), so a low-power signal is a common problem. Considering the faint sound of a "beep, beep, beep" in the first place, the challenge increases exponentially when static or interference is added.

Remember that, unlike the Voice of America, the British Broadcasting Corporation, or other major international broadcasters, time signals are not broadcast for DXers; they are broadcast to fulfill a technical need. Getting a QSL card from a time signal station is usually more of a courtesy than a necessity, unless the reception report is from within the country itself. This isn't to say the stations don't appreciate your responses; most actually welcome international replies, and are highly efficient when answering reception reports.

A Few Easy Targets

Besides CHU and WWV/H, try VNG on 12984 kHz around 0500 UTC. YVTO may be on 5000 kHz around the same time as well. Stations RWM, 4996, and RID, 15004, kHz (both in the former Soviet Union) are almost always around 15000 kHz; their "woodpecker" signal (continuous, rapid pulses) identifies them almost instantly. You will have to tune up or down 4 kHz (depending on which station) in CW mode to hear them clearly and independently, but they're still easy catches.

Intermediate signals are HD2IOA, Ecuador, on 3810 kHz. Try this one very late at night, around 0600-0700 UTC. Unlike YVTO, it broadcasts a full station ID every half-hour (at 15 and 45 past). The announcement, in Spanish, uses a male voice. VNG, Australia, on 2500 is also a good try; this one may be somewhat harder, since it broadcasts mostly to the Sydney region. For longwave DXing, try MSF, Rugby, England on 60 kHz. Being in the longwave bands, it will not broadcast any voice announcements. It also lacks Morse IDs. BPM, China, on 15000 kHz is often active. It uses a special form of UTC which advances the signal a few milliseconds before that of WWV/H, so it will be slightly off-mark. It also has a very distinctive ID at 15 and 45 seconds after the hour: Morse code repeats "BPM, BPM, BPM," followed by a female Chinese voice repeating the call letters three times, followed by an announcement.

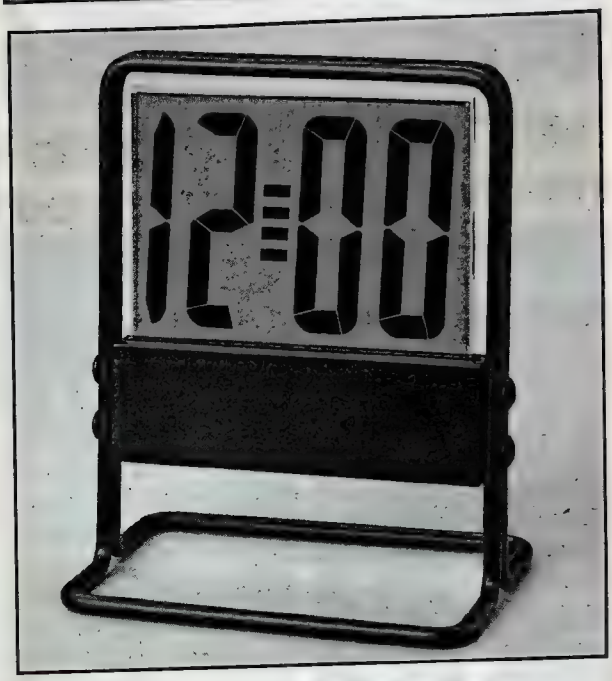
Interested in a harder catch? Try JJY, Japan, on 2500, 5000, 8000, 10000, and 15000 kHz frequencies. JJY broadcasts the same format as WWV, including tones. It has a Japanese voice announcement before each minute. Any other station on Fig. 2 including India, Indonesia, Korea (from which only one person within the U.S. has QSLed), or even Italy is a tough catch! If you have any success hearing or QSLing these stations, or if you have questions regarding time signal stations, please write to me c/o *The Tick-Tock Times*, 1119 Parkwood Avenue, Rockford, IL 61107. ■

Key Words In This Article

DXer: a radio enthusiast who regularly listens for distant stations

QSL: A written verification, usually a card, that acknowledges reception of a station, or in the case of amateur radio, it acknowledges a two-way contact.

NBS: National Bureau of Standards.



Radio Shack catalog number 63-729 clock.

For Further Information

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Souping Up Your Scanner

There's plenty you can do to improve your scanner's performance. Read on, there's a lot to learn.

By Bill Price, N3AVY

Your new scanner is a week old, and you want to buy it something for its birthday—but what can it *really* use? Relax and take a seat, class is just about to start.

I've never brought home a new car that I didn't find myself buying some accessories for the next day, though I've graduated from fox tails on the antenna to sensible things like a CD player and a mobile scanner. And how about you? Now that you've brought home that new scanner, what can *you* do to improve its performance?

Well—it has no carburetor to adjust, and you can't give it high octane gas. Like today's cars, the electronics are really sophisticated, and no place for a tinkerer. Hmmm. C'mon, class—say it with me: an-TEN-na. Good!

Some Questions and Answers

The best scanner you can find won't do you a bit of good if the signals can't find their way into it. That's where the right antenna comes in.

Most scanners come with a built-in antenna, and, although it will work fine, it's the one thing that *really* lets you improve upon your scanner's performance. As a matter of fact, there's a whole array of antenna options to choose from.

"So how do I pick one?"

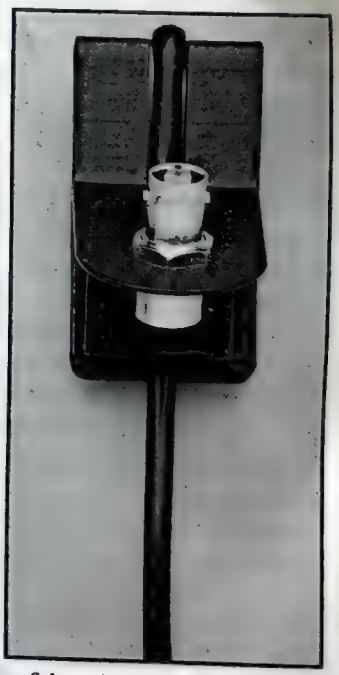
That's easy; you play the question game. First of all, is your scanner portable, mobile, or for the home? For portable use, the flexible "rubber duck" antenna is probably the best *all-around* performer. If you're going to be in one place for a while—say a campsite—I'd switch over to a center loaded-telescoping whip because it gives you the best performance from a portable antenna. You can't beat the flexible "duck," though, for walking through the woods or carrying the scanner on your belt.

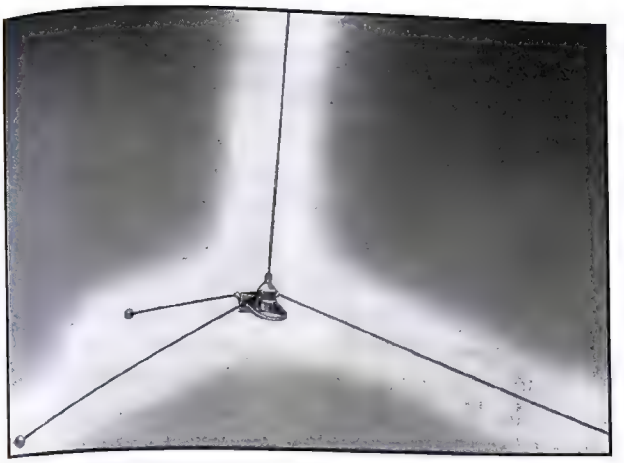
"Yeah—and the duck works pretty well in the car, too."

I'm sure it does, but did you ever think of putting your duck *outside* the car? No, I don't mean hanging your arm out the window. There are two ways to mount your rubber duck on your car. One is a BNC clip-on glass mount, and the other is a BNC antenna glass mount which holds your antenna on the *inside* of the window—right where it can grab those signals without being exposed to the weather. There's also a cellular "look-alike" glass-mount mobile scanner antenna that doesn't need any mounting holes because it just mounts on the glass (the wire is on the inside).

(Left) The flexible rubber duck antenna that comes with most handheld scanners is adequate for most situations.

(Below) The BNC Clip-On Glass Mount Antenna (20-022) mounts your flexible antenna outside your vehicle.





The VHF-Hi/Air/UHF Scanner Roof Antenna (20-176) has three stainless steel horizontal radiators and accepts a PL-259 connector.

The BNC Antenna Glass Mount (20-022) is an ideal antenna for folks who want to keep their flexible antenna inside their vehicle. It includes a 6-foot cable.

And, of course, there's the old standby, the magnetic mount, that lets you remove your scanner antenna whenever you leave your car.

"OK, that takes care of the car, but why can't I leave the rubber duck antenna on my scanner when I'm at home?"

Well, you can—if you're going to be moving the scanner from room to room with you. But if you're going to keep it in one place, you'll want a larger antenna for home use, something you can mount outdoors.

"Hold on there. I live on the top floor of a high-rise apartment building, I can't put anything outdoors."

No problem. Either use an indoor plug-in, all-band antenna mounted right on the scanner itself, or a center-loaded telescoping whip mounted on the antenna glass mount. You can fasten it to the sliding glass doors to your balcony, for instance.

"How about me? I own my own home, and I want the best performance possible. Would it be worthwhile to put an antenna on the roof? Would I notice any difference over the telescoping antenna that came with my scanner?"

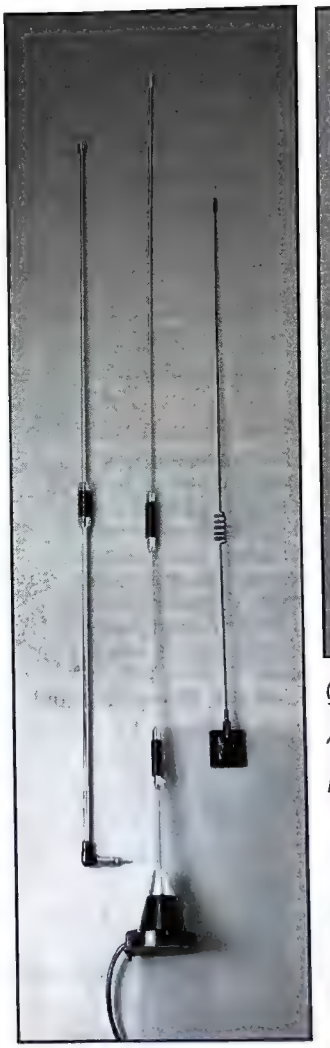
You bet! There are several roof-mount antennas to choose from. There are discones which will cover all the way up to 1300 MHz, models that cover VHF-HI, Air, and UHF, and models that cover all bands.

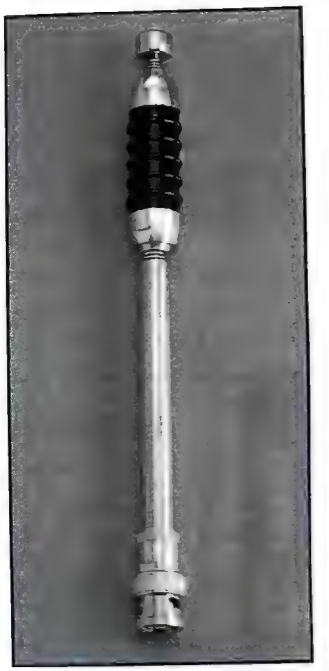
"And how about the mounting hardware to put it up?"

You'll need an assortment of brackets to mount antennas and masts on your roof, on the side of the house, or to the chimney. You can find guy wire, grounding kits and ground rods, and all the antenna hardware you need. There's also a complete line of connectors and adapters to make sure part A fits into part B with no problem. It's simple enough to get everything pulled together: just ask the sales personnel at your favorite store.

"How high should I mount my antenna?"

When you're erecting your antenna, height is your friend. The signals that scanners pick up travel in a straight line. If you were on a boat and you wanted to see land, you'd climb the mast, right? In certain situations, raising an antenna 5 feet can make a significant difference. First, though, a brief word from *Dr. Safety*:





(Above) The Center-Loaded Telescoping Scanner/Ham Whip Antenna (20-006) receives 25-1300 MHz. Hams can also transmit on 144, 220, 440, and 1296 MHz ham bands.

(Left) Shown here (left to right) are the Indoor Plug-In All-Band Scanner Antenna (20-161), Magnetic-Mount Mobile Scanner Antenna (20-012), and Cellular "Look Alike" Glass-Mount Mobile Scanner Antenna (209-011).

WARNING: HEIGHT IS DANGEROUS, PARTICULARLY WHEN IT IS ABOVE SOMETHING HARD. BE CAREFUL. PLAN AHEAD. REMEMBER, POWER LINES ARE DEADLY. READ AND FOLLOW ALL WARNINGS INCLUDED WITH YOUR ANTENNA. YOU ARE NOT AN EXCEPTION.

Equipment for Souping Up

For a one-stop shopping source for equipment mentioned in this article, you can consult the Radio Shack catalog. Products and their catalog numbers are as follows.

Center loaded-telescoping whip (20-006)
BNC Clip-On Glass Mount (20-023)
BNC Antenna Glass Mount (20-022)
Cellular "look-alike" glass-mount mobile scanner antenna (20-011)
Magnetic mount (20-012)
Indoor plug-in, all-band antenna (20-161)
Center-loaded telescoping whip (20-006)
Roof-mount antennas: VHF-HI, Air, and UHF (20-176); All-Band (20-014) and Discone 20-013
Antennas—Selection and Installation (62-1083)
Spike protectors (61-2787)
Grounding blocks (15-909)
Antenna discharge units (15-910)
Ground rods (15-529)

Lightning, Static Discharge, and Surge Protection

Remember the knife fight scene in *Butch Cassidy and the Sundance Kid*? Remember when Butch wanted to discuss the rules, and the big guy said, "There ain't no *rules* in a knife fight?" Well, that's about how it is with lightning. It *will* strike twice in the same spot, and it will ignore most wives' (and husbands') tales. But there are things you can do to minimize the risk from lightning.

The top of the Empire State Building, the Eiffel Tower, and probably your nearby radio and television stations' towers have all been struck by lightning—sometimes with little or no adverse effect. Why do you suppose that is?

The answer is proper grounding and installation in accordance with appropriate electrical codes. That's easy for me to say, but it's one of those rare times when I'm serious. There are things you do when you know a lightning storm is coming, like unplugging your equipment, unplugging the antenna lead-in and grounding it. Amateur radio operators in your area will usually be more than happy to share their knowledge on the subject. Your local power company often has literature and sometimes offers special lectures to groups such as radio clubs. It's not a topic which can be covered in a page or two, but it is an area where you can often get free help or information.

To protect your antenna and your scanner, use spike protectors, grounding blocks, antenna discharge units, ground rods, and proper installation. If you have questions regarding lightning protection, your local building department can refer you to the appropriate electrical codes, or you can contact a licensed electrician in your area who can advise you about requirements.

The manufacturer's recommendation for installing and grounding your antenna are your best starting point.

"So where did you learn all this stuff?"

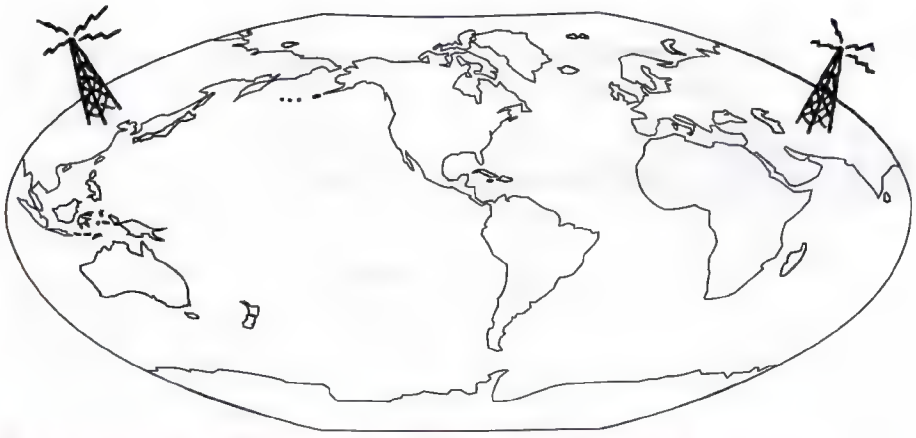
I picked up a little when I was a radioman for the Coast Guard back in the Sixties, but scanner and antenna technology has improved a lot since then. Get the book I refer to, Radio Shack's *Antennas—Selection and Installation*—it will give you a good understanding of antenna basics. If your curiosity makes you want to learn even more, maybe you should consider amateur radio as a hobby. The article "Getting Your Ham Ticket" in this issue can help you get started.

"And where will I get the rest of the information I need?"

From my friend Bernie at the Radio Shack right up here at Routes 17 & 28. Tell him I sent you and he'll give you the friendliest service this side of the Mississippi.

"Wouldn't he give me friendly service anyway?"

Of course he would, it's just an expression. Go see Bernie, and get yourself an antenna. ■



DX Antennas For Better Shortwave Reception

A good antenna is easy to build, and will give you countless hours of improved listening.

By Bill Orr, W6SAI

More and more people are becoming interested in long range (DX) shortwave reception. And why not? It's exciting to hear news from around the world as it happens or music and commentary from far off places.

Would you like to hear what Radio Iraq thinks of the U.S.? (You won't like it!) Or perhaps you would like to hear the latest news out of China or India. What's going on in Cuba? Radio Havana Cuba will give you Castro's latest line. And there's plenty of Latin music from South America and Africa that provides unusual melodies. The easiest to hear are the various powerful shortwave stations in the U.S., including the Voice of America, but it's also easy to get worldwide news from the many transmitters of the British Broadcasting Corporation (BBC). Radio Moscow will tell you about the latest developments taking place in that unhappy country.

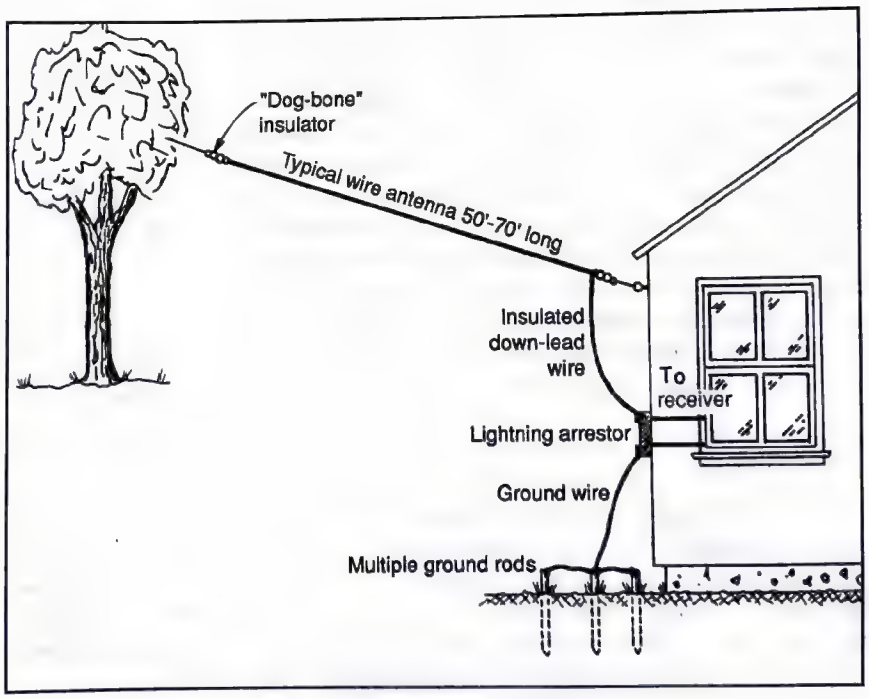


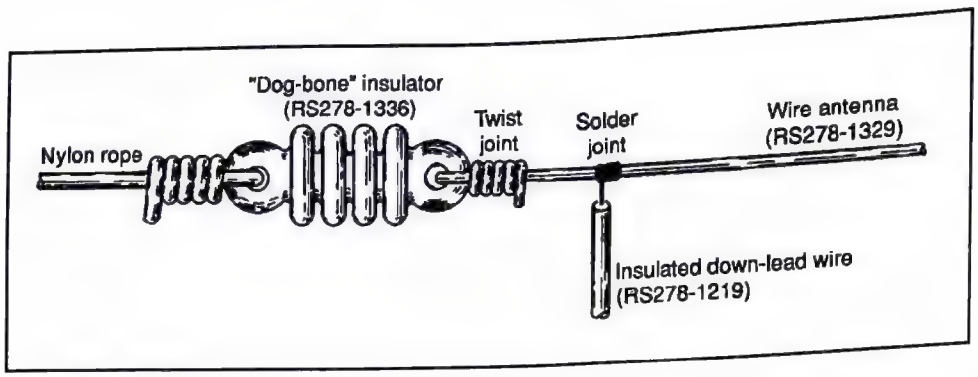
Figure 1.

There's a lot going on in the world of shortwave radio. The truth is, almost every country in the world has its own shortwave broadcasting facilities. Some are government controlled; some are not. But all of them are fascinating to listen to. You can hear these signals and lots of other broadcasters with a shortwave receiver. In addition to monitoring regular broadcasting, you can eavesdrop on ships at sea, overseas airline flights, clandestine (pirate) broadcasts, radio hams, and miscellaneous unusual signals whose source is unknown and whose purpose is a mystery.

Your Key to Success—A Good Antenna

This article will tell you the secret of good shortwave reception. It is very simple—you need a suitable antenna in

Figure 2.



a good location to consistently bring in signals from afar. Follow the information in this article and the world will be at your fingertips!

Radios with Built-in Telescoping Antennas

Yes, you can hear all the fascinating broadcasts. All you need is a shortwave receiver—and a good antenna placed in the best possible location. Each type and style of radio has its own antenna requirements; some of the radios even solve the problem for you with a built-in antenna. Inexpensive AM/FM entertainment radios have built-in "loopstick" antennas. Every user of these gadgets knows that moving the radio about will cause AM broadcast stations to peak in volume when the radio is placed in a position that gives the loopstick maximum signal pickup. And so it is with any shortwave receiver. Antenna placement is very important for long distance reception. The portable battery-operated "all-band" receivers have a built-in, telescoping whip antenna for shortwave reception. Some combine the whip with an auxiliary connection for an optional external antenna. Some "communication" receivers dispense with the whip entirely and depend only upon an external antenna supplied by the listener.

The Telescoping Whip Antenna

Let's first talk about receivers equipped with a telescoping whip antenna. These sets should be operated with the antenna fully extended. Reception is usually strongest when the whip is in a vertical position; however, when the receivers are used indoors, the house electrical wiring (or the building itself) may affect reception. It's a good idea to experiment with the position of the whip and the location of the radio. In some instances, reception may be clearest with the whip in a horizontal position or at an angle. If you are in a steel frame building, you may have a serious reception problem—it's difficult for signals to penetrate such a structure. (On the other hand, if you are living atop a hill in a wood frame house, with no nearby electric utility wires, you'll have excellent reception compared to a location surrounded by hills and nearby power lines.). An auxiliary antenna is the best solution to such a problem, although some listeners have had luck merely walking around their home with the radio in hand and placing it near windows until they find the "sweet spot" that affords best reception.

Radio Noise and Static

While you're searching for the area of best reception, you'll find it helpful to keep the radio away from local radio noise sources. Fluorescent lights, light dimmers, television sets, computers, and electric motors are all sources of radio noise, which can be identified as a loud, rough buzz that covers up the signals you are trying to hear. A plug-in AC interference filter on the offending household appliance can reduce this type of interference to your receiver. This radio noise is much different from static, which is natural noise caused by atmospherics and thunderstorms. Static is identified by loud, irregular bursts of noise and usually occurs during the warmer, summer months. You can't do much about static unless your radio is equipped with a "noise blanker," which often helps reduce loud static crashes. Sometimes radio noise is introduced into the house via the electric power lines. If you are using an AC adapter to power your set, disconnect it and run the set on internal batteries to see if the noise level drops. Isolating the receiver from the power line often reduces unwanted radio noise. Placement of the radio and use of the internal battery supply provide the best insurance against radio noise and the best guarantee of good reception.

How Much Antenna is Enough?

Your radio antenna intercepts thousands—perhaps hundreds of thousands—of radio signals flashing around the earth at the speed of light. It picks them all up, for better or worse, and when you tune your receiver you select the particular signal you wish to hear. The ability to hear weak signals depends upon the sensitivity of your receiver and the pickup ability of your antenna. Most of today's receivers have adequate sensitivity to do the job, provided the antenna can "grab the signal out of the air."

You can boost the weak signal response of many whip-type shortwave receivers, particularly if they are located in a less-than-optimum receiving location, by making the whip longer. You can do this with a length of #20 solid hookup wire and an electrical clip. Clean the insulation from one end of the wire, attach the clip to it and then clip the wire to the top of the telescoping whip. Get the wire as high in the air

as possible. If you're inside a wood frame building, run the wire around the ceiling of your room. You can hold it in position with thumb tacks, or run it out the window and tie it to a nearby bush or tree.

How long should the wire be? Well, if it's too long it will affect proper receiver operation. If it's too short, it won't do much good. I suggest you obtain a wire about 20 feet long and try it (see Fig. 1). If the receiver chokes up, or doesn't sound right, coil the wire up into a hank, starting at the far end. Just wrap it around your hand. This will shorten the pickup ability of the wire. If you find that the receiver comes to life when the free length of wire is, say, 12 feet long, clip off the excess wire. Then get the remaining wire as high up in the air as you can.

If this doesn't improve receive signal pickup, remove the electrical clip and simply wrap one end of the insulated wire around the telescoping antenna. Try about 10 turns, but experiment with the number of turns and length of wire until signals seem the loudest. There's no electrical connection between the whip and the wire, the coiled turns do the job.

One of the positive aspects of using the coiled wire technique is that it will work with a much longer wire than will the direct connection using the electrical clip. It is possible to use up to 50 feet of wire, placed as high as possible, preferably with the main length of it outdoors. Again, adjust the number of turns on the coil for best reception—only a few turns will be required. You'll be impressed with the results.

These inexpensive antenna extensions often work quite well. A friend of mine bought a low-cost "all-band," battery-operated portable receiver. His receiving location was not very good, being situated between rolling hills. He listened to some of the loudest signals then started to look for some of the weaker ones that his friends had told him about. Alas! Nothing there. He tried a short wire extension for the whip. That helped a bit, but I pointed out to him that a better solution was at hand with . . .

. . . A Professional Clip-on Antenna

If you want to experiment with an extended wire antenna the right way, a portable shortwave antenna is ideal. These contain many feet of wire on a compact storage reel, and the free end of the wire clips over the telescoping antenna of the receiver. The listener then reels out the wire, listening to a shortwave signal. By experimenting, the length and placement of the wire are adjusted for best signal strength. In addition to home use, this gadget is ideal to take on a vacation when you want to keep in touch with the world via your portable receiver! For best results, toss the wire in a tree as high as you can get it.

Receivers Using an Auxiliary Antenna

As I mentioned earlier, some all-wave portable receivers have a jack for an external antenna located on the back or side panel of the set. The external wire is very helpful, especially if you are out in the "sticks," away from your favorite AM or SW broadcast station. Most of the powerful all-band receivers can benefit from an auxiliary antenna, even if they have a telescoping whip. Data on suitable antennas is sometimes included in the instruction manual of the receiver. Suitable antennas for these sets are discussed later in this article.

What Makes a Good Antenna and Where Do You Put It?

It's not hard to build a good wire antenna. The effort spent in erecting the best antenna you can will result in improved reception. You'll be able to dig down and bring out the weakest signals. Here are some suggestions for you that will make the time and money spent on your antenna a good investment.

The antenna should preferably be outdoors and as high in the air as possible. I'd say 20 feet above ground is a minimum height for good reception. Some radio hams place their antennas over a hundred feet in the air for extreme long distance results. You don't have to go to this lofty height, but do get your antenna as high in the air as you can. I've settled on a height of 30 feet as a good compromise, since I have a nearby tree that I can climb to that elevation.

Location of your antenna with respect to nearby objects is important. Telephone and power lines have a shielding effect on a nearby antenna. Stucco buildings having a wire mesh

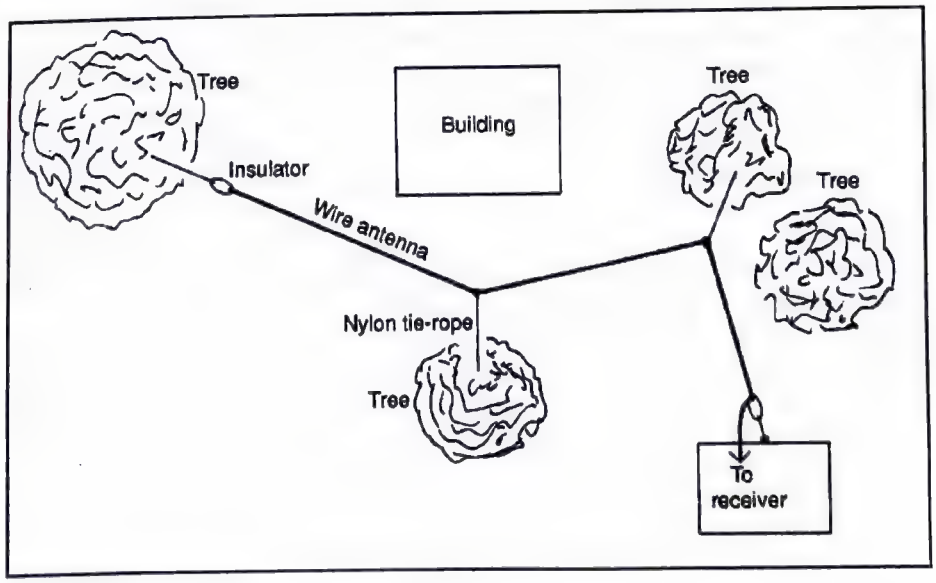


Figure 3.

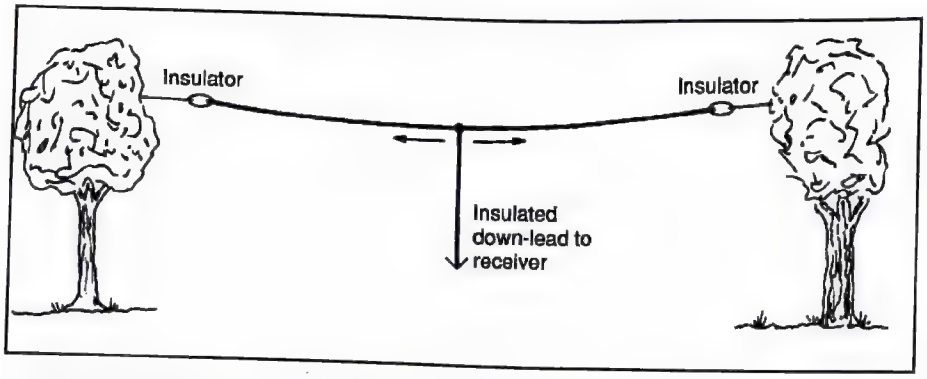
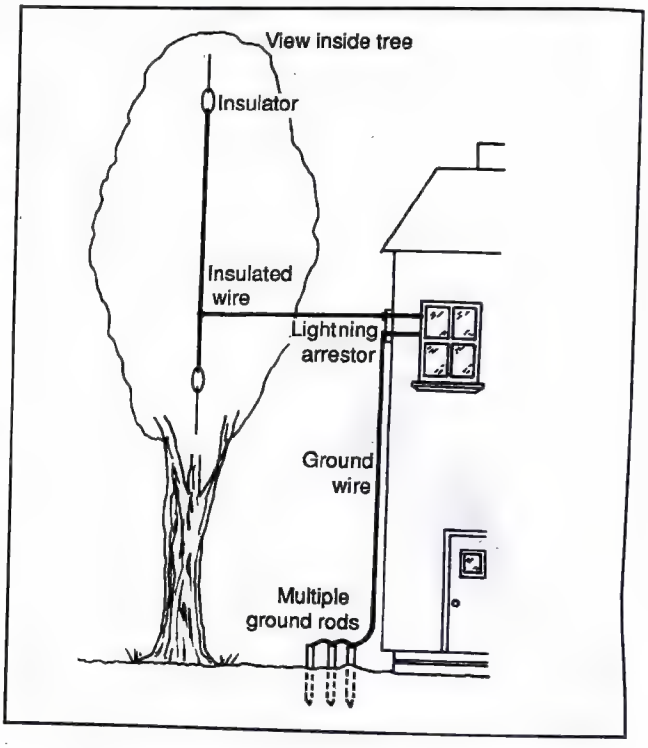


Figure 4.

Figure 5.



in the walls are also a detriment to good reception if your antenna is placed near them. Keep your antenna clear of all these objects and also of nearby buildings if possible.

Many overhead power lines, especially the older ones and the ones carrying very high voltage, may have broken or leaky pole insulators which produce severe radio interference. This will show up as a loud buzzing noise covering almost all shortwave frequencies. This noise can interfere with broadcast reception as well. The further your antenna is located from such lines, the lower the level of interference. Orientation of the antenna with respect to the power line for minimum noise pickup may help in some cases. Try to keep it from running parallel to the line.

Another source of radio noise is the common light dimmer. Interference-proof dimmers can be bought, and you may have to remove a dimmer in your home and substitute a noise-free one to get satisfactory AM and shortwave reception. Keep this in mind.

It is a good idea, too, to keep your receiving antenna clear of a TV antenna. TV sets can radiate radio noise from their circuits that interfere with radio reception on any band. Make sure the antenna you build is sturdy and well-made. Occasionally, you'll read in the newspaper of an antenna breaking and falling across a power line and electrocuting the listener. Build the antenna right. Haywire is out. Stay away from power lines.

Make sure if your antenna comes down that it will not fall upon or touch a nearby utility line. Having contemplated these common-sense warnings, let's look at some practical receiving antennas that will do the job for you.

An Inexpensive General Purpose Antenna

Decades of use by countless DX enthusiasts have shown that a single high-wire is an excellent general purpose all-wave antenna. It's the perfect antenna for the beginner, as it works well on all frequencies, including the broadcast and long wave bands. You can find all the components to build one at Radio Shack and many hardware stores. See Fig. 1 for details.

You can run the antenna from a window near your receiver to a tree, pole or other support on your property. Don't run it on someone else's property as that might stir up trouble with a testy neighbor.

Make sure the antenna touches nothing else. A tree branch scraping the antenna wire can make scratchy noises in your receiver. And, as I've said before, keep the antenna well clear of telephone and utility wires. The antenna should be made of wire sturdy enough not to come down in a windstorm, and it should have enough slack in it to absorb stress if the support (such as a tree) moves about in the wind.

You need a length of antenna wire, two "dog bone" antenna insulators and support ropes. Generally speaking, stranded copper wire is the best for an outdoor antenna, as solid wire tends to kink more than stranded and is more easily broken under stress. I suggest 14-gauge, 7-strand bare copper wire. This comes in a 70-foot length, which is just right to do a good job. In a pinch, you can use solid, enamel-coated magnet wire as a temporary antenna. Insulated wire will also work alright, as radio signals easily penetrate the insulation.

Place a dog bone insulator on each end of your flat-top section. Just loop the wire through the insulator hole and twist it back on itself (Fig. 2). You don't have to strip the insulation (if any) from the wire or solder these connections, but you do have to solder the down-lead wire to the flat-top wire.

Most builders make the down-lead portion of the antenna

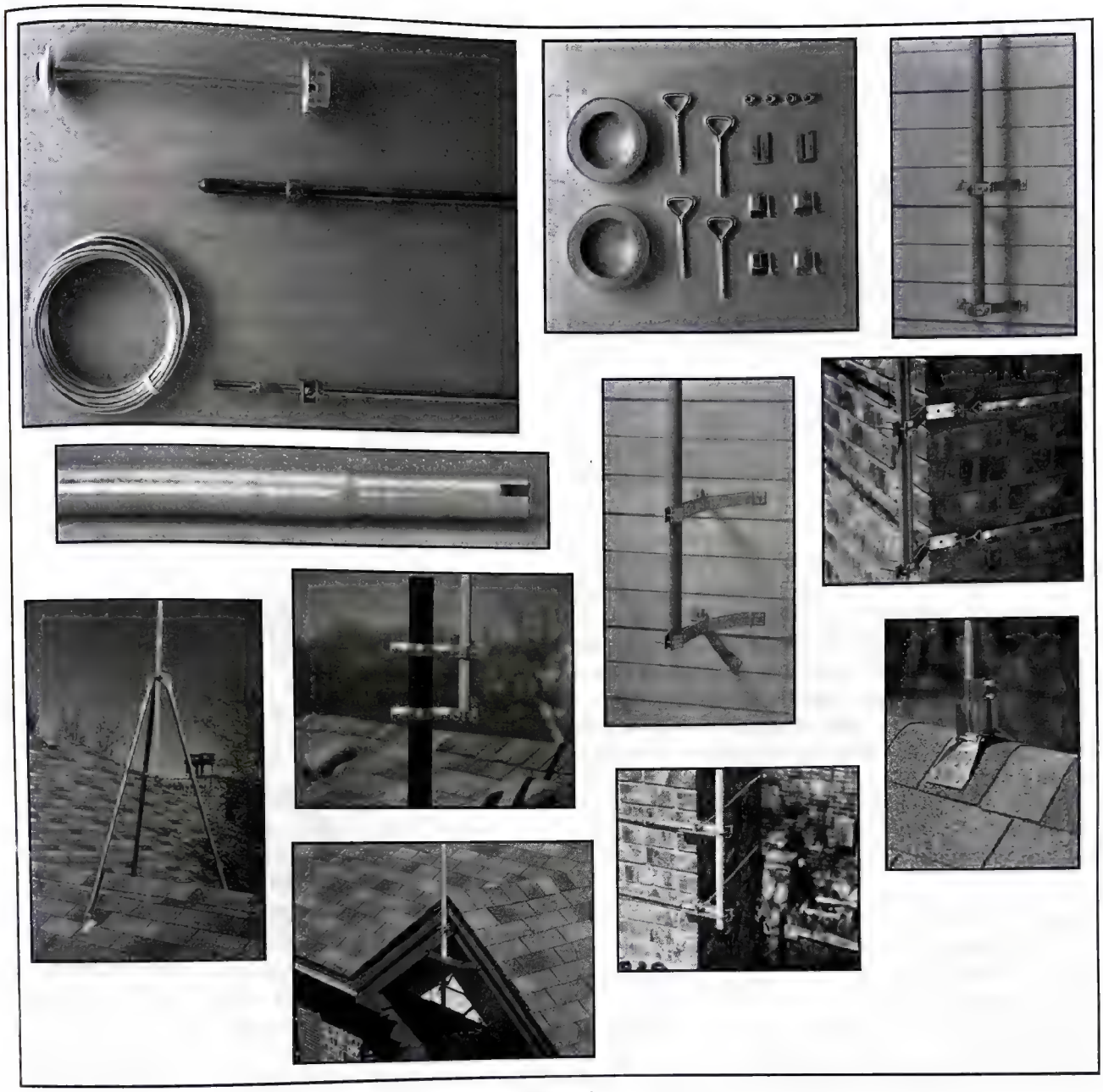


Figure 6.

out of insulated hookup wire that can slip under the window when it's closed. It is a good idea to use insulated wire in any case so that inquisitive hands (kids) can't actually touch the copper conductor. (There was an instance in the past where a child received a shock by touching a bare antenna wire because of a defective component in an old tube-type radio that placed voltage on the antenna.) Length of the antenna is not critical. At a minimum, I'd say that antenna plus down-lead wire should be at least 50 feet long and any overall length up to 125 feet is alright. Bear in mind that a long antenna may cause receiver overload, especially if you live near a local broadcast station.

You can get an antenna kit that has all the parts you'll need to erect a good 75-foot "sky-wire," including a 50-foot insulated down-lead and appropriate insulators.

The down-lead wire is soldered to the antenna end nearest your receiver. Strip the insulation off the wire down about two inches and wrap the exposed portion around the antenna wire. This joint should be soldered and then wrapped with RF connector sealant tape. This pasty material will protect the joint from the weather and inhibit corrosion of the wires.

Place the horizontal portion of the antenna as high in the air as you can. Don't fasten the end to a utility or telephone pole! That is dangerous, and it is an invitation for noise pick-up from the lines.

Actually, the antenna doesn't have to run horizontally. It can slant up or down, or run in a zig-zag fashion to avoid obstacles. You can tie it in position with nylon cord, which is impervious to the weather (see Fig. 3).

The first choice is to run the wire in the clear, but if you have a two-story home and the roof is non-metallic (wood or composition shingles), you can lay the antenna directly

Figure 7.

on the roof or mount it slightly above it. A chimney is a good tie-off point. The direction in which the antenna wire runs is not important. Exotic beam antennas have to be oriented with respect to a distant area you wish to receive, but such is not the case with this sky-wire, as it is relatively nondirectional.

Leave a little slack in the antenna, especially if one support rope is tied to a tree. Once the antenna is erected, bring the down-lead wire into your home and attach it to the antenna terminal of your receiver and enjoy!

Finally, note that the down-lead need not be connected to the *end* of the flat-top wire. If it is more convenient, attach it at any point along the wire (see Fig. 4).

The Indoor Antenna

Those listeners living in apartments or rented property sometimes find, to their sorrow, that the landlord or property manager takes a dim view of an antenna wire running over the premises. Then, too, some residences have a clause in their lease or sales contract prohibiting outdoor antennas. A solution to this problem is to place your antenna indoors. If you have an attic area, string the antenna up there. Some listeners have found that a short wire clipped to the metal frame of a sliding window or door serves as a good antenna. A wire tacked around the ceiling of a room will work, too.

One listener hooked his down-lead wire to a downspout of the rain gutter and reported good reception. There are many solutions to this problem if you look about you. But don't try hooking your antenna to any electric power or telephone line. Again, that's dangerous, and, in addition, might destroy your receiver.

A Vertical Receiving Antenna

The obvious advantage of a vertical antenna is that it takes up very little ground space. It can be made of tubing and bolted to a chimney, or made of insulated wire and supported inside a tree (see Fig. 5).

The main disadvantage of the vertical antenna is that it is very responsive to static and man-made noise—more so than a horizontal antenna. Some communication receivers have a noise blanker which will help to overcome this annoying problem. I suggest if you live near a busy highway avoid a vertical antenna because of the automotive noise pickup. Having said that, the fact remains that a vertical antenna functions as well as a horizontal antenna. It can be mounted against the wall or on the roof of a house and no support is needed for the top end (see Fig. 6).

Sections of TV-mast make a good self-supporting vertical antenna. One 10-foot and one five foot section will do the job. Plenty of hardware exists to mount the antenna to a chimney, to the roof, or to a wall . The mast sections should be fastened together to form a good electrical connection. Self-tapping screws, or pop-rivets will do the job. The last step is to run an insulated lead-in wire from the vertical antenna to your receiver.

Most users of vertical antennas have come to the conclusion that a mast length of 15 feet is sufficient, considering that the lead-in wire length counts as part of the antenna.

There's no reason a vertical antenna can't be taller, but that involves the use of guy ropes to steady it. I don't think it's worth the effort to use a length greater than 15 feet.

Generally speaking, your antenna doesn't have to be installed in either a vertical or a horizontal position. Don't be afraid to use a tilted wire for an antenna. As long as you get the antenna up in the clear, away from nearby objects, antenna positioning is relatively unimportant. Survey your available space and use your imagination!

The Indoor Amplified Shortwave Antenna

A recent exciting new electronic development is the indoor amplified shortwave antenna. This is a compact, battery

BAND	FREQUENCY RANGE (MHz, approx.)	LENGTH L (feet, rounded)
11	25.4 - 26.1	18'
13	21.45 - 21.75	22'
16	17.5 - 17.9	26'
25	11.6 - 12.0	40'
31	9.5 - 9.9	48'
41	7.1 - 7.4	65'
49	5.8 - 6.2	76'

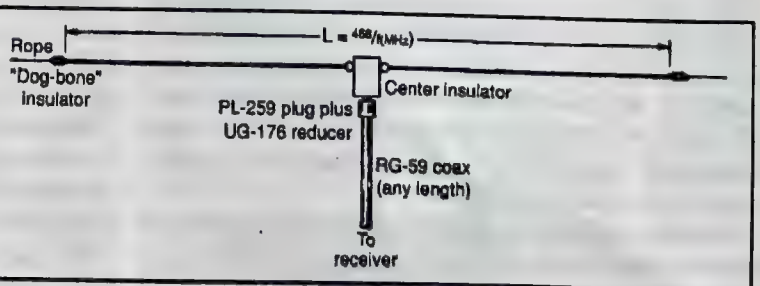


Figure 8.

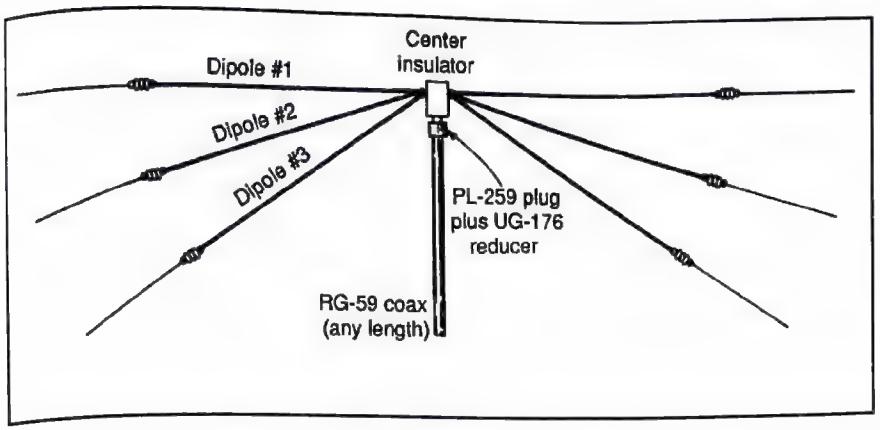


Figure 9.

operated device that combines a short whip antenna with a sensitive, tuned signal amplifier (see Fig. 7). It's powered from internal batteries or from an AC adapter. The tuning range is 3 to 30 MHz in two bands.

Amplifier gain is adjustable to suit your receiver and the device is tuned to the frequency range to which you are listening. Reception rivals that which you would enjoy with a much larger outdoor antenna. Some listeners use both an outdoor antenna and an indoor amplified antenna unit, switching back and forth between them for best reception from a particular station. If you're restricted from using a larger antenna, this is the solution for you. Check your receiver to see if it has an antenna jack suitable for use with the amplified antenna.

The Dipole Antenna

The dipole antenna (see Fig. 8) is very popular among shortwave listeners and radio hams. In its simplest form, it is a single-band device, that is, its length is cut to provide superior performance on one specific shortwave band. The drawback of the dipole is that its performance falls off badly as you tune away from the band for which it is designed. It's a specialty antenna and is often used as an alternative to, or in addition to, a single wire antenna, such as described previously. I don't think it is the best antenna for a beginner who wishes to tune all bands, but I think it is a fine antenna for an advanced listener who wishes to concentrate on one frequency range. Generally speaking, a dipole is useful over a span of about 1 MHz. For example, a dipole cut for the 15 MHz broadcast band will perform efficiently over that range, but it will be a poor performer on, say, the 9 MHz band.

The dipole length is related to the frequency of reception in MHz (megahertz) by a simple formula:

Dipole length (in feet), tip-to-tip = 468/frequency in MHz.

For example, suppose you want a dipole antenna for the 25-meter broadcast band (approximately 11 to 12 MHz). The center frequency of the band is 11 MHz. Plugging 11 in the formula provides a dipole length of about 39.66 feet, or 40 feet, rounded to the nearest foot (dipole lengths are not very critical). Or, if you want a dipole for the 49-meter broadcast band (approximately 5 to 6 MHz), the overall length (based on a center frequency of 6.05 MHz) is about 76 feet. Get the idea? Dipole dimensions for the most popular shortwave broadcast bands are given in the illustration.

The dipole wire is split in the center by an insulator and the two ends are connected to a coax cable used as the lead-in. The center conductor of the coax is attached to half of the dipole while the shield is connected to the other half. The coax of choice is RG-59/U.

A special dipole center insulator is available which supports the dipole wires and provides a connection to the coax line. I recommend you buy one of these special insulators, as wiring the coax to the dipole can otherwise be a tricky process since it's necessary to make the junction waterproof. The center insulator requires a matching plug, type PL-259 plus a UG-176 reducer to fit RG-59 cable. The plug at the receiver end of the coax depends upon the antenna terminal connections of the receiver. You can sometimes buy coax with the plug and reducer attached. Ham handbooks give information on attaching the plug to the coax if you decide to make your own connection.

The length of the coax line is unimportant. Listeners have used lengths up to 100 feet in order to place the dipole in an advantageous position.

Note that the dipole is most responsive to signals arriving at right angles to the wire. Signals arriving off the ends of the antenna are attenuated to a noticeable degree. Some listeners place two dipoles at right angles to each other, using separate feedlines, and switch back and forth between the antennas for optimum reception.

Remember, the dipole is a single-band receiving antenna

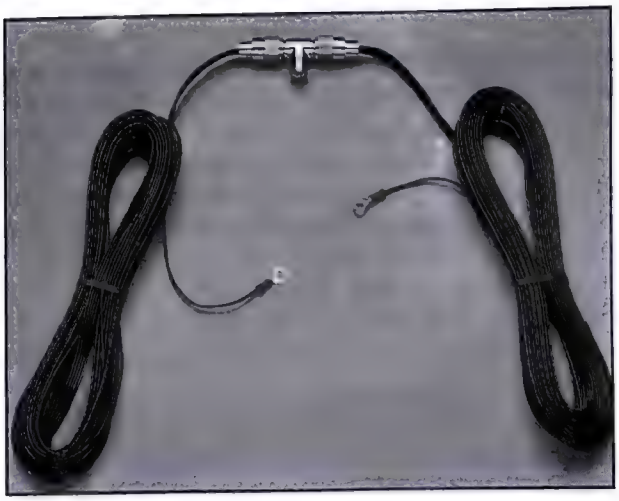


Figure 10.

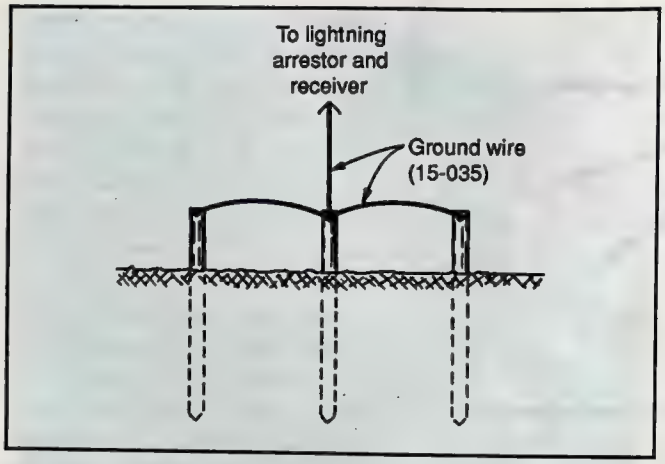


Figure 11.

and not an all-purpose one. It does what it is supposed to do very well, but it has its limitations.

The Multiband Dipole

For good reception on two or more bands, dipoles may be connected in parallel at the center point (see Fig. 9). The free ends of the dipoles should be separated a few feet from each other, but they may run in any plane, not just in the vertical plane, as shown in the drawing. For example, dipoles cut for the 25-, 31-, and 41-meter bands may be connected in parallel for superior reception on these three bands. A more complex dipole, suitable for operation on 10 bands is discussed in the next section.

Both the single and the multiband dipoles may be erected in an inverted-V configuration from a single high support, placed at the center. The ends are tied off to convenient supports high enough above ground so that someone will not inadvertently walk into them.

The Multiple V-Dipole

In order to overcome the frequency restriction of the dipole, a multiple wire, inverted V-shaped dipole is available which is responsive to the 10 major international broadcast bands (see Fig. 10). In addition, because of the multiple wires, the antenna works well on frequencies outside the broadcast ranges, so good reception is possible over the whole HF spectrum from about 4 to 30 MHz. The antenna can be mounted in the attic in an inverted-V position. It can also be mounted outdoors on a single mast, or attached to the roof eaves. The overall length of the V-dipole is 65 feet.

A suitable length of RG-59 coax cable equipped with a coax connector and reducer to fit the dipole receptacle is required. The connector is a PL-259 plug plus a UG-176 reducer.

Antennas for "Tough" Situations

Living in a mobile home? A condominium? An area which frowns upon outside antennas? Cheer up. All is not lost. If you live in a wood frame or masonry building, I suggest you use an indoor antenna. Aluminum siding presents a problem, and most listeners report poor results when an indoor antenna is used with this type of construction. A few find an indoor antenna works alright if the radio signal can enter via a window or a wood roof. Check it out. Generally speaking, an outdoor antenna is mandatory when the receiver is in a metal structure. High-rise apartments with a steel frame fall in this category, too.

You can use an "invisible" outdoor antenna with good results. The single-wire antenna is made of #24 or smaller "magnet" wire. Insulators are home-made of small diameter clear plastic rod, and the antenna is supported by twine or fish line. If the antenna is 15 or 20 feet in the air, it is very hard to see from the ground!

An invisible antenna is fragile though, high winds, icing or a collision with a bird can quickly bring it down. However, it works, and works well. I had an invisible antenna at my summer home a few years ago. It ran from the roof of the house to a pine tree about 80 feet away. Five years later, when we sold the house, it was still up, and the new owner never noticed the antenna until I pointed it out to him.

If you live in a high-rise, you face a different problem. One solution is to lower an invisible antenna wire down the outside of the building. You can hold it out from the wall with a small stick or wood rod. Place it so it doesn't pass in front of a window beneath you. To play it safe, you can haul it in when you are not using it. Try to keep it two or three feet away from the side of the building. Don't worry if it doesn't hang straight.

Another idea is to use the metal rain gutter or porch railing of a building for an antenna. This often works surprisingly well. Merely run a wire with an alligator clip on the end to the gutter or railing and clip it on, making contact to the metal surface.

If you are in a wood frame building with an attic, that is an ideal place for an antenna. Or, the antenna can be laid on a wood shingle or composition roof, as I mentioned before.

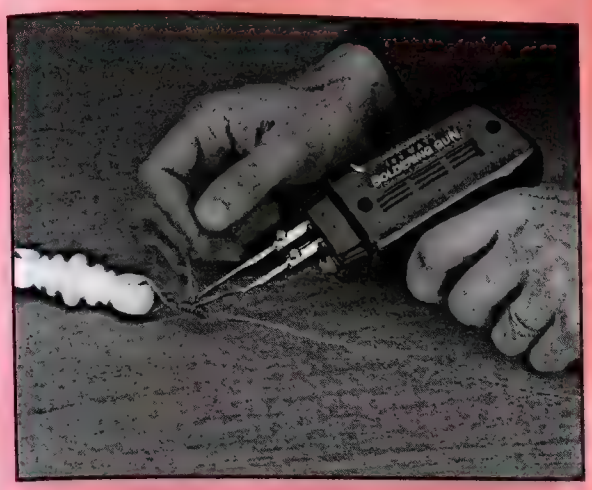
The Ground Connection

Every schoolboy knows you must have a ground on a radio. Right? Well, maybe so back in the days of your grandpappy's battery operated Radiola receiver. Today's receivers, however, have an internal radio ground through the AC power cord and often don't need an external ground connection at all. There is one exception to this statement. If you do a lot of listening in the broadcast and longwave bands, or in the shortwave bands below 5 MHz, you might achieve a reduction in man-made noise with a good ground connection. Noise often enters the receiver via the power cord and often this racket can be reduced or eliminated with a good, multiple ground (see Fig. 11).

This connection is made up of three short ground rods driven into the soil and connected to each other. The only advantage of a long ground rod is that you get good exercise pounding it into the soil. Two-foot long rods are good enough. Buy

Soldering Techniques for Wire Antennas

Connections between antenna wires, or between wires and coax, must be strong mechanically and also make good electrical contact. A solderless mechanical connection may work loose or corrode, causing an intermittent connection between the wires resulting in poor or noisy reception.



To do the job, you need the right tools. I prefer a soldering gun over an iron because it heats up and cools off rapidly and the heating element is not directly exposed to cold weather. In order to bring the wire up to temperature, you'll need a husky gun, of 100-watt capability. Electrical solder (as opposed to plumbing solder) should be used. Rosin-core solder should be used for electrical work.

The secret to successful soldering is to have the joint hot enough and then to bring the solder to it. As you touch the solder to the joint, apply the gun tip at that point. The solder will melt smoothly and flow over it.

Once the joint is completed, it must be protected from the weather. The best protective material is outdoor RF connector sealant . This is a tape-like, pasty substance which can be molded around a connection to form a flexible, waterproof wrap. It is excellent protection for all electrical connections exposed to the weather.

an 8-foot rod and cut it into three sections. Drill a hole for a connecting bolt in one end and drive the other end into the ground. The rods should be about three feet apart. Connect the rods together with bolts and lengths of ground wire, then run a single wire to your receiver ground. The longer this wire is, the less effective will be the ground.

The Long, Low Antenna Wire

Some experimenters have found that a very long, low wire is effective for shortwave reception at the lower frequencies (below 10 MHz). The low wire has inferior signal pickup, but it picks up static and man-made noise even less, so there is an overall improvement in signal-to-noise ratio. One popular design consists of 200 to 300 feet of insulated wire placed directly on the ground. Another installation consists of about 150 feet of wire run along the top of a wood fence. Signals are quite weak with these antennas, but reception is very quiet. It is easier to understand a weak signal with little background noise than a much stronger signal with plenty of noise. You will have to experiment with a low antenna. The best way to check it out is to compare results with a high wire antenna. In some cases, the long, low wire may be better than the higher wire.

The Antenna Experimenter

Experimenting with antennas is a lot of fun. Many enthusiasts have several antennas of different types, running in different directions. They choose the antenna that will give the best results on the shortwave band of interest. Wire is cheap and a big roll of it will give you a lot of enjoyment (and good exercise) putting up experimental antennas. Put up an antenna of your choice and enjoy good listening! ■

Products in this Article

For a one-stop source of antennas and accessories mentioned in this article, consult your Radio Shack catalog. Parts and catalog numbers are as follows:

Part	Cat. No.
Plug-in AC interference filter	15-1111
#20 solid hookup wire	278-1222
Electrical clip	270-356
Portable Shortwave Antenna	278-1374
14-gauge, 7-strand bare copper wire	78-1329
Enamel-coated magnet wire	278-1345
Dog bone insulator	278-1336
Insulated hookup wire	278-1219
Antenna kit	278-758
RF connector sealant tape	278-1645
10-foot section TV-mast	15-843
5-foot section TV-mast	15-842
Mount (antenna to chimney)	15-839
Mount (antenna to roof)	15-516
Mount (antenna to wall)	15-886
Indoor amplified shortwave antenna	20-280
RG-59/U coax	278-1315
Type PL-259 plug	278-205
UG-176 reducer	278-204
Inverted V-shaped dipole	20-181
RG-59 coax cable	278-1315
PL-259 plug	278-205
Ground wire	15-035
Soldering gun, of 100-watt capability	64-2193
Rosin-core solder	64-004
Outdoor RF connector sealant	278-1645

In Review: Radio Shack 22-305 Frequency Counter

By Ed Juge, W5TOO

If you've been wanting a good, portable frequency counter, but hate to pay the high prices advertised by many manufacturers today, check out the new Radio Shack unit, the 22-305.

Counters are extremely useful for setting transmit frequencies of HTs and other transmitters. Used properly, they're helpful in tuning intermediate circuits and signal tracing, adjusting receiver master oscillators, and any number of other tasks. A counter will never go to waste in the hands of a ham, CBer or electronic hobbyist.

Let's Take a Look

The first thing you notice about Radio Shack's new counter is its heavy-duty, rugged look and feel. It looks like a very high-quality piece of equipment, not—like so many today—something mounted in two pieces of bent metal. Yet its compact size lets it fit easily in a shirt pocket.

The large eight-digit display is a pleasure to use. Because it's an LCD display, it is actually *easier* to read when you use it in direct sunlight. The backlighting is a trifle dim, but is more than adequate for night use.

The nominal frequency range of the 22-305 is 1 MHz to 1.3 GHz in two ranges, with the break at 50 MHz. You will find, however, that it will operate above and below that range with somewhat reduced sensitivity. A hefty 19-inch telescoping antenna (supplied) attaches to a BNC fitting on the top of the case for measurement of nearby transmitters. A cable (not supplied) can be used for direct frequency measurements. Switches select power on/off, 50-Ohm or high impedance input, and frequency range above or below 50 MHz. Two push switches toggle between slow and fast gate speed and turn the backlighting on for several seconds. If you hold the button down for at least two seconds, the light will stay on until you turn off the counter.

The counter uses four "AA" batteries, or can be powered from a 9 Vdc adapter (Radio Shack part no. 273-1455 or equivalent). The adapter uses a center-negative plug, and must supply 300 mA of current at 9 Vdc. When batteries are used, a small internal switch must be set for either alkaline or nickel-cadmium (NiCd) battery type. When NiCd batteries are installed, they will be charged when an AC supply is attached. Radio Shack suggests replacing alkaline batteries every year. To warn you of low AC voltage or a low battery, a decimal point will light to the right of the digit farthest right (and you'll probably get erroneous frequency readings as well).

The rugged, compact Radio Shack 22-305 Frequency Counter.

Be careful to set the frequency range switch properly. If you don't, you'll get an incorrect frequency reading. Gate speed is either slow (display updated every 1.28 seconds and reading down to the nearest 100 Hz) or fast (almost instantaneous display and 1 kHz resolution).

Measuring the frequency of an amateur transmitter is as simple as extending the antenna and pressing the transmitter's push-to-talk switch. If you connect an optional coaxial cable, you can measure frequencies from an oscilloscope or other high-impedance input probe. Be sure not to exceed 1.4 V peak-to-peak, or you might damage the counter.

Radio Shack rates the counter's accuracy at 1 part per million +/- 1 count on the least-significant digit. The display update rate is 128 mS or 1.28 seconds (fast or slow gate).

I have used a number of counters and looked over a number of others. This is by far the most professional and rugged unit I have found marketed for amateur or CB radio use. The price ($99.99) makes it truly affordable for just about anyone. Check it out! ■

We're America's Supplier of Communications Accessories!

Communications enthusiasts trust Radio Shack for the "extras" they need. Take the sting out of static with one of our performance-boosting antennas for home or car. Or, add an extension speaker to keep the signals coming in loud and clear.

No matter what your favorite "band" is, Radio Shack offers a complete line of receivers and accessories to help you get the most from your home, mobile or portable communications equipment. Drop by today—we're right in your neighborhood!

Radio Shack®

ETC. ETC. ETC.

Buying a CB Radio

So, you're going to buy a Citizen's Band radio. Which one is best for you? Here are some of the offerings from Radio Shack.

By Walter G. Green III
Chairman, REACT Citizen's Band Committee

Now that you're considering purchasing a CB radio, the choices probably seem endless. There are so many different kinds. And what about features? Well, try not to feel overwhelmed. There are a few simple questions you can answer for yourself that will help guide you in your search.

The first big question is, of course, "Do I need a CB, or is another type of radio best for my needs?" If you're interested in radio as a hobby and are technically inclined, the greater flexibility that amateur radio offers may make CB a second choice. Amateur radio may also be a vital safety tool if you live or play in very remote areas. If you're a coastal boater, a Marine VHF radio will give you reliable communications with the Coast Guard when disaster strikes. However, if you want local communications for business, public service, or fun, or a way to talk to family members in another car on a long trip, or a way of summoning help on an interstate highway, Citizen's Band is probably your best bet.

How Many Channels?

Today, this question is almost moot—the answer is 40! With the exception of some handheld radios, all modern CBs are now 40-channel radios. When CB went to 40 channels in the 1970s, the FCC withdrew the "type acceptance" for older 23-channel radios. Basically, this means they no longer met technical requirements for signal quality and susceptibility for generating interference. The 23-channel units are not supposed to be resold, although there are a lot of second-hand units out there. It's very hard to find people who know

(Left) A handheld CB transceiver with detachable antenna.

(Below) If you're concerned about someone stealing your mobile CB,use the Radio Shack slide-mount, catalog number 21-566.

how to fix them, parts are often impossible to find, and their signals can cause interference with several household appliances. All in all, it's a bad buy, unless you are a collector.

Base CBs

CB radios come as base, mobile, or handheld radios. Base radios are so called because they're used as a base radio station, meaning in a fixed location. A base CB is your best choice if you intend to use the radio for personal enjoyment, i.e simply talking to other CB operators, or if you are interested in public safety work. A base station at home also allows you to communicate with other family members who have mobile radios. And, if you are using a CB for business or farming, the base can save you a lot of time: CB base units run on standard household power—you plug it in, connect an antenna, and you're operational.

Base AM (more about AM and SSB later) models are limited to 4 watts output power, so your antenna and its location is critical. A high-quality, high-gain antenna in a good location (with top quality coax cable connecting it to the radio) results in a station that can usually be heard for 20 miles. Good antenna location means height above the ground. Because much of CB operation is line-of-sight, the signal from your radio antenna must travel straight to the other antenna. One antenna must "see" the other. By law, your maximum antenna height is 60 feet above ground or 20 feet above the structure on which it is mounted. On flat ground, a 60-foot antenna can see about 8 miles, one that's 36-feet high about 6 miles, and a handheld at face level about 2 miles. In a worst case scenario, using an inexpensive antenna, with poorly installed, old coax in a location blocked by buildings may achieve a mile range. I'd suggest using the Radio Shack Crossbow Base Antenna (Radio Shack catalog number 21-1549). It's 16 feet high and constructed of rugged fiberglass. You connect it to either your existing mast (up to $1^5/_8$ inch diameter) or high-quality aluminum poles, as shown in the Radio Shack catalog.

The crossbow base antenna.

There are different types of base radios. You can get one with controls that basically turn the unit on and off (volume control and squelch) or one with a lot of meters, switches, and knobs to turn. In spite of what you may hear, for most operators, there is not much difference in actual radio performance. After all, performance is what matters, right? To talk to your friend down the street, you don't need a top of the line radio. If you're buying a new base to learn about the technical side of radio, because your operating location is not very good, or to answer weak emergency calls for help, then the bells and whistles become more important. The meters for signal strength, SWR (standing wave ratio), modulation, etc., help you determine how your radio and antenna system are working. The controls, RF gain, noise limiting, noise blanking, microphone gain, etc., all help you adjust what you hear for varying conditions. For most people, the best way to buy a base is to pick a moderately-priced piece of equipment as a first radio. When you're more experienced and have found your particular interests, consider upgrading to top-of-the-line units such as the TRC-492 (21-1549) which

Using CB is an ideal way to summon help on the road.

Handheld CB has many uses, from camping to construction.

has automatic noise limiter and blanker circuits, plus emergency Channel 9 and 19 buttons, an RF gain control, signal-strength and channel LEDs and jacks for an external speaker and headphones.

What About Single-Sideband?

CB base and mobile radios are available in both AM or single-sideband (SSB) models. An AM signal occupies a relatively broad section of a radio frequency. The advantage to an AM-only CB is that it's simple and inexpensive to manufacture, so you'll spend less money for an AM-only CB. The disadvantage is that the signal takes up a lot of radio space. SSB takes the normal AM (amplitude modulated) radio signal and modifies it to concentrate the signal in a narrower amount of radio frequency (either a lower or upper sideband). The signal is stronger (SSB radios are allowed 12 watts output, versus 4) and range is therefore greater (all things being equal, about twice the range of a typical AM CB). A second advantage is that there is a group of operators specializing in SSB as a hobby. Sideband users can receive registered numbers from the SSB Network, Box 908-A, Smithtown, NY, 11787 for a large self-addressed stamped envelope. This group is considerably more fun to talk to than many who only use Channel 19! Most sideband activity is on LSB channels 36 to 40. The TRC-465 (21-1567) is a 40-channel AM, plus upper/lower sideband mobile CB that includes an auto-noise limiter, RF gain, PA jack, and costs $169.99.

The disadvantages to SSB? Well, for one, price—though the difference is not really *that* much. Also, you need at least two people with SSB radios to talk on sideband, and in many parts of the country there just isn't that much SSB activity. Finally, no one monitors SSB channels for emergency calls.

The Radio Shack SWR/Power meter, catalog number 21-524.

Mobile CBs

Mobile radios are ones that operate in mobile locations, most commonly in cars, but also in boats and aircraft. A mobile unit makes sense if your primary need for a radio is when you are on the move. Mobile radios, such as the Radio Shack TRC-482 (21-1551), can come with all the sophistication of base radios. Some models have even allowed operation on multiple channels at the same time or reception of National Weather Service broadcasts. They do require some work in installation. If you feel really comfortable working on your car's electronics, you can do the job yourself. A quality installation by a professional technician, however, can save you a lot of possible car problems later.

Most of the advice for choosing base stations applies to mobile radios as well. If you need the CB to talk to your friends around town, a less expensive model, such as the

WE'RE AT HOME ON THE RANGE

Radio Shack's 40-channel TRC-226 CB Walkie-Talkie is a real workhorse. With a full 5 watts of power, center-loaded antenna with TNC connector and ceramic filter, the TRC-226 is designed for serious CB communication. A rugged exterior and solid construction make it a dependable companion on long rides. And it's backed by 6600 Radio Shack stores nationwide, so we're always in your territory if you need help.

For keeping in touch on the range, a job site or in the wilds, Radio Shack carries a complete line of handheld CB radios. From reliable 3-channel budget models to full-power 40-channel performers, there's no better way to communicate across the wide open spaces.

LONG RANGER

TRC-479 (21-1519) will do the job. But, if you're someone who needs the performance, such as severe weather spotter or a traveler to fairly unpopulated areas, the added features of a more expensive rig will make a difference.

In mobile radios, antennas are even more important than they are in a base installation. Good placement on the vehicle to get the maximum value of the car's body in reflecting the signal will double or triple range. A good mobile antenna system can reasonably be expected to send a signal three to four miles on level ground, and five to eight miles is possible. With a high performance antenna system, such as the Radio Shack Twin Truckers (21-945), which is also great for mounting on truck/van mirrors, I have seen operators easily communicate 15 miles in disaster exercises on AM mobile CB radios! An ideal location for a magnetic-mount antenna is the center of your vehicle's roof. One such antenna, the Radio Shack Deluxe Magnet-Mount (21-960), includes a 54-inch whip. There are no holes to drill; simply place the antenna on the vehicle, connect the cable to your rig and you're in business. This type of antenna is particularly useful for the traveler who isn't interested in a more permanent antenna installation. There's also a CB/AM/FM antenna if you're concerned about the appearance of extra antennas on your new vehicle.

Handheld CBs

Finally, there are handheld radios, also called portables or walkie-talkies. Handhelds can offer up to 4 watts in output power, although many are 3 watt, 2 watt, 1 watt or 300 milliwatts and all are AM. Although you'll see handhelds advertised as 5- or 7-watt radios, they still only transmit about 3.5 to 4 watts RF signal. CB radios can legally only have 5 watts input, which yields about 4 watts output. Period. A 4-watt signal from a 5-watt radio is the same as 4 watts from a 7-watt radio.

The more expensive models have all 40 channels, although you can find 6, 5, 3, and 2-channel models. Radio Shack has three handhelds with 40-channels and the maximum legal power (5 watts input, 4 watts output). These range in price from $79.99 to $139.99 Depending on your needs, other models with fewer channels and less power, ranging from $29.99 to $59.99, might suit you. These units include Channel 14 crystals, with space for one or two more channels. Extra crystals are $4.99 per pair. Always include Channel 9 as one of those crystals for emergency use (if you have more than one radio, put Channel 9 in the same slot in each radio). Make a label with your channel assignments and tape it to the radio with waterproof tape. There are few things funnier than watching two people trying to figure out at night in the rain which channel is which on six-channel radios.

Obviously, the big advantage of the handheld is portability. You can now find 40-channel, 4-watt radios that fit easily in a brief case or backpack. They are convenient for work as well as for a variety of recreational uses. The disadvantages are range and battery operation. Typically, because you are limited to either a telescoping whip or flexible rubber duck antenna, maximum range is about three to four miles under good conditions. The lower-powered units will give you less range—a 300-milliwatt radio is probably good for use under a half mile in most situations.

Power is the other disadvantage. If you use a handheld as a portable radio, be prepared to replace batteries every eight hours under normal use (when you are actually transmitting less than a tenth of the time). This will vary depending on battery quality. But, frankly, most portable radios, depending on how loud you keep the volume and how frequently you transmit, eat batteries! Convenient rechargeable batteries are becoming more and more popular, however, they do work and are worth the investment if you use your radio a lot. The charger (21-516) simply plugs into the recharge jack, or you can operate the rig from your car, truck, RV or boat's 12-volt battery. The Radio Shack 12VDC power cord (270-1533) is eight feet long and plugs into the DC power jack.

A Word about Theft

These days it pays to be extra careful when installing mobile radio equipment. It takes a thief only a few seconds to pry your CB from under the dash, so do what more and more CBers are doing—use a slide-mount such as the Radio Shack 21-566. At only $17.99, it's cheap insurance against theft! All your CB's cables, including antenna, connect to the fixed part of the bracket that attaches under your vehicle's dash. The other part of the bracket is attached to your radio. Simply slide the radio/bracket in and out when parking your car. The radio goes with you, not with a thief! Coupled with the magnetic-mount antenna, that you've removed from the roof, you have just theft-proofed your CB installation. An alternative to using the slide-mount for your radio is to use the Radio Shack Portable Hump Mount (21-540) and a cigarette lighter adapter plug.

The Emergency Radio Systems

One special type of handheld radio is the emergency global radio. Designed to be carried in your car for use only during roadside emergencies, they're not designed to be used at highway speeds or as a day-to-day primary radio. They are typically battery powered with a magnetic mount antenna. The Radio Shack TRC-463 (21-1558) costs $69.99 and includes all 40 channels, an emergency Channel 9 priority switch, magnetic mount antenna, cigarette lighter power cord and storage case. The TRC-460 (21-1559) is also battery operated (in case your vehicle battery is dead) and includes a U.S. Weather Service receiver. It costs $89.99.

Don't Forget the Accessories

When you purchase a CB radio, you'll also have a choice of accessories. It's easy to come back later, if you must, but

plan your installation before you walk in the store. Some things that can help your handheld include:

• *A separate microphone.* Not every handheld will accept a microphone, but, if yours will, holding the radio up at arms length and using the microphone may give you an extra mile or so range when you need it. It also makes it a lot easier to use the radio as a backup mobile radio.

• *Antenna adapters.* Check to see if an antenna adapter can be attached to allow you to use a vehicle, or even base, antenna. A 4-watt output handheld is as powerful as a base or mobile (remember, 4 watts is 4 watts) and gives you an emergency backup. In a recent power failure, I was able to keep my public safety station running by using my handheld and attaching an antenna adapter to the coax, which, in turn, connected to my outdoor antenna. The people whose calls for help I answered didn't know the difference.

• *Flexible antenna.* If you go into the woods with your handheld or if you are going to use it in tight places, a flexible "rubber duck" antenna is a lot less likely to break or bend. The tradeoff is that, because it is shorter, your range suffers. A rubber duck antenna on a CB is probably good for about a mile in most situations, but a mile or so is better than trying to operate with a broken antenna!

• *Spare metal rod antenna.* Metal telescoping rod antennas give you antenna length and thus more range. Always buy a spare antenna and put it safely away where you won't lose it. (I probably have five or six of every handheld radio antenna ever made, as I keep buying spares because I can't find the one I bought last month!). Spares are usually simple to install and will get you back on the air quickly.

• *Protective carrying case.* A handheld radio, whether CB, ham or scanner, takes its share of bumps and bruises. The Radio Shack Protective Carrying Case, 20-004 for $9.99 is an excellent investment that protects your handheld from dust and water and the abuse handhelds often receive.

• *Power supplies.* A vehicle cigarette lighter power cord or base power supply saves your batteries when operating the handheld as a mobile or base. The Radio Shack Power Supply (22-120) is only $39.99 and is rated at 2.5 amps continuous—enough to power your mobile CB from AC.

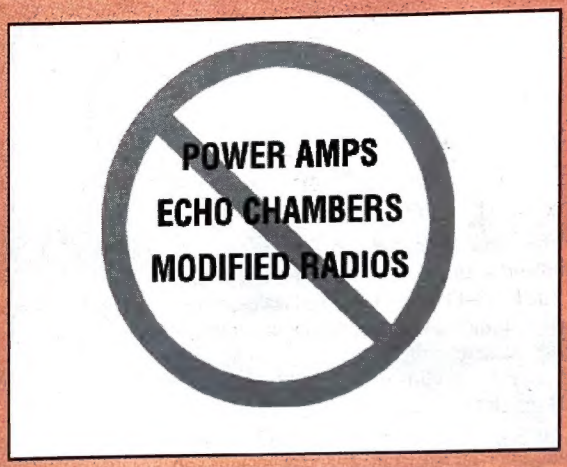
• *Extension speaker.* Available from Radio Shack as either an amplified model or standard model, these speakers dramatically improve the sound of smaller mobile CB speakers. You can mount them anywhere in your vehicle (without obstructing your vision).

• *SWR/Power Meter.* Many operators leave an SWR meter in their antenna line permanently to measure standing wave ratio and power output. It's an indicator of antenna system performance that's hard to beat.

I hope that these tips have helped you make your decision. Once you do purchase your CB, I'm sure that you'll find it an excellent traveling companion on those long trips, a way to locate highway trouble spots and a great way to stay in touch with family and friends. ■

Things NOT to Buy

There are three things not to buy: a power amplifier, a modified radio, or an echo chamber. Power amplifiers or "linears," are a big deal among illegal operators who want to send their signal across the US (you are limited to contacts at no more than 155 miles by law!) or who want what they call, "real talk power." But, they also splatter their signal across as many as a dozen channels locally, making communications for other people virtually useless—including emergency highway safety, disaster, and search and rescue communications! The amplified signal often interferes with other communications services and degrades the signal quality of the CB itself. The FCC takes a dim view of this and, from time to time, confiscates radios and frequently fines operators thousands of dollars. If you want to talk across the country, study for your amateur license. Be part of the system, not someone who tries to operate illegally.



Modified radios are bad news. You literally don't know what has been done to the radio. It may be transmitting a signal on a wide variety of frequencies other than the intended one. The channels assigned to CB cover radio frequencies between other services, including military, search and rescue, and business services. If someone tries to sell you a CB with "special low and high band channels" it is operating outside the legal frequencies. You end up interfering with other legitimate radio operations - even endangering lives. The FCC doesn't think much of this and routinely takes operator's money and radios for not being very bright.

Echo chambers reverberate your voice. They're ok if you're a rock star, but usually the only person who thinks the effect is neat is the person with the echo chamber or someone who wants to be as hard to understand. The surest way not to get help when you need it is to use one of these gizmos. Public safety communicators don't have the time to try to figure out your message from among the electronic garbage you are sending out.

Radio Shack Highlights

News

Thirty-one Leninsky Prospect may not sound familiar, unless you happen to live in or near downtown Moscow. That's the address of the first Radio Shack store in the former Soviet Union.

The store opened officially in mid-December with lots of fanfare, including live coverage by ABC's "Good Morning America" and "CBS This Morning," as well as a visit by the mayor of Moscow.

Muscovites now have the opportunity to purchase many electronic products never before available to Russian consumers. Communication products including shortwave receivers, ham radios, scanners, CBs, antennas and numerous other accessories are expected to be popular items with shoppers. Russia and its surrounding republics may boast the greatest concentration of amateur radio operators of any region in the world.

For decades, ham and shortwave radio were the only open channels from the Soviet Union to the outside world. Since the dramatic changes accompanying Glasnost and the new reform movement, the lines of communication have opened even wider for Russian citizens. Those who want to experience the fun and excitement of amateur radio or those who simply want to listen to news and views from other nations can now do so.

The Moscow store is not Radio Shack's first foray into the international marketplace. Through an aggressive program to establish itself as an international retailer, Radio Shack stores and dealers are now operating in more than 30 countries around the world. Radio Shack International is constantly seeking new opportunities to put quality electronics products within reach of consumers throughout the world.

Radio Shack has experienced tremendous growth since 1963 when Charles Tandy bought a handful of Boston electronics stores. Today, it is the largest retailer of consumer electronics products in the U.S. and is now leading the way toward satisfying pent-up demand for quality electronics at affordable prices in other nations.

Our globe is shrinking, in part because of greater communication among nations. As a leading marketer of highly respected communications products, Radio Shack is playing a significant role in improving this communication.

Next time you're in Moscow why not drop by the Radio Shack at Thirty-one Leninsky Prospect. You'll probably feel right at home! ■

Products

The PRO-43 Programmable Scanner (Cat. No. 20-300)

The PRO-43 200-channel programmable scanner is the best handheld scanner ever offered by Radio Shack.

The PRO-43 offers keyboard access to over 48,000 frequencies used by police and fire departments, military and commercial aircraft, and many other services including the 800-MHz emergency-service band. Radio Shack's exclusive HyperScan® system searches through frequencies at 50 steps per second.

The triple-conversion Superheterodyne receiver virtually eliminates interference from other frequencies and provides clear reception of the selected frequency.

The PRO-43 is loaded with popular features including a 10-channel monitor bank, priority channel selection, 2-second scan-delay, keyboard lock, audible low-battery indicator and an easy-to-read, backlit LCD display.

The unit comes with a handy belt clip, detachable flex antenna, BNC antenna jack, and jacks for earphones and power adapters.

Suggested retail price: $349.99.

(Frequency coverage, MHz): 30-54; 118-174; 220-512; 806-823; 851-868; 896-999.)

Micronta SWR/Power Meter (Cat. No. 21-524)

The Micronta SWR/Power Meter is a valuable accessory for CB and HF ham radio enthusiasts.

This accurate instrument is useful in testing and tuning CB and amateur radio antennas to achieve top performance.

The standing wave ratio (SWR) function helps adjust the antenna to the precise length for maximum transmitted power. The power meter function provides accurate measurements of the transmitter's peak envelope power (PEP) or average power output.

The SWR/Power Meter covers 3-30 MHz and handles up to 2000 watts. It can also be permanently coupled to equipment for easy readjustment.

Suggested retail price: $29.99.

The TRC-493 Mobile CB with Digital Signal Processing (Cat. No. 21-1590)

Radio Shack's TRC-493 40-channel Mobile CB Transceiver represents a breakthrough in CB design technology.

It features a Digital Signal Processor (DSP) circuit that dramatically improves audio quality by eliminating background noise and static commonly heard on crowded CB frequencies. The DSP can be switched in and out as needed.

Other TRC-493 enhancements include RF gain, squelch, and a full-time automatic noise limiter (ANL), for virtually noise-free reception. It also features a large LCD channel indicator, a 4-step LED signal/power meter, and noise control for adjusting the frequency response of the audio signal being monitored.

The emergency channel switch allows instant access to Channel 9 for reporting an emergency.

Jacks are provided for adding optional external personal or public address speakers.

The TRC-493 comes in a universal mounting kit for easy installation in a vehicle. With an optional power supply and base station antenna, the TRC-493 can double as a base station transceiver.

Like all Radio Shack mobile CBs, the TRC-493 includes a microphone with coiled cord and a locking plug.

Suggested retail price: $149.99. ■

"Granddad Always Said Nothing Could Beat The Excitement Of The Big Bands.

Then I Introduced Him To The *Action* Radio Bands."

Now he enjoys radio monitoring with the 80-channel PRO-2030 scanner from Radio Shack. Its action bands deliver the most exciting listening of all—*news as it happens.* Police and fire departments at work, government services and more. Granddad's hooked! And no wonder, thanks to:

800-Megahertz Band. Covers the newer public-service frequencies for reception of emergency services not heard on many other scanners.

VHF-Aircraft Band. Monitors aircraft communications between pilots and control towers.

One-Touch Weather Band. Delivers National Weather Service reports and forecasts for the local area.

HyperScan™. Searches for new frequencies and scans stored frequencies at a fast 50 channels per second.

You can bet that Granddad's new PRO-2030 will get a real workout. For easy listening to the hottest bands, he says it's the *only* way to go.

Radio hobbyists' headquarters for 73 years. Radio Shack®

"Up here, having clear communication with my partner is a must. We rely on our TRC-506 hands-free walkie-talkies to keep in touch, and they've never let us down."

Radio Shack's rugged, dependable 2-way headset radios are lightweight and feature-packed! Look what's built into them:

Dual-conversion superhet receivers drastically reduce interference so speech is clear and intelligible.

49MHz FM operation is ideal for short-range (up to ¼ mile) applications. Provides clear transmission with less noise and interference than Citizens Band.

Voice-activation, with selectable sensitivity control, helps you keep your hands on what's really important.

"We're serious about our fun. No way we'll settle for gear that will leave us hanging. That's why we chose Radio Shack."

The Fun Starts Here!

Radio Shack®